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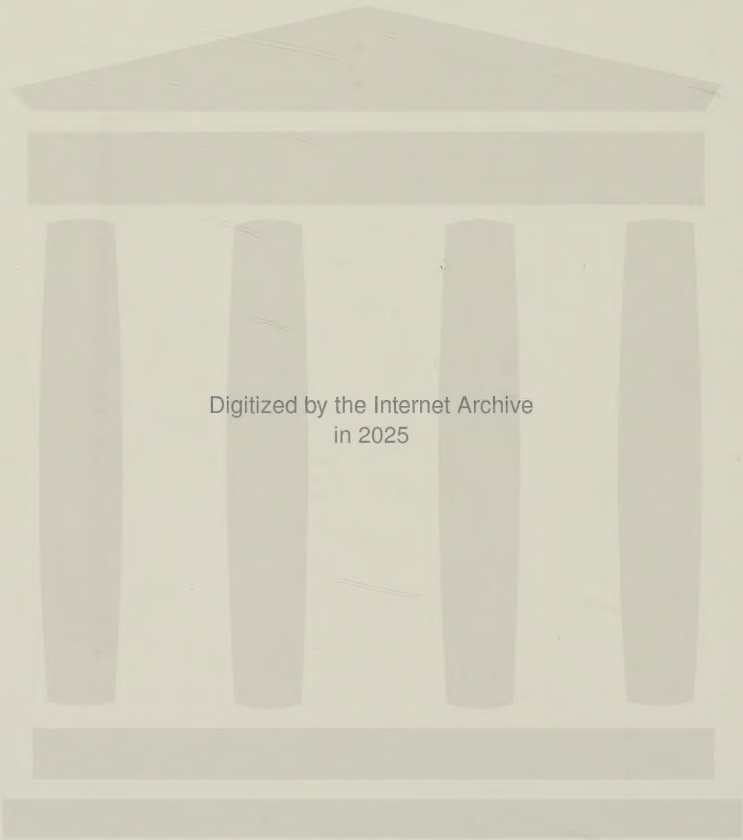

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Project identification in small pelagic fisheries: Indonesia, India, Thailand, Morocco

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PREPARATION OF THIS DOCUMENT

This document is the final output of the Project to Improve the Handling of Small Pelagic Fish (GCP INT 298 DEN) funded by the Danish Government under a funds-in-trust agreement with FAO. The document attempts to consolidate the results of investigations in the four countries as investment profiles for improved fish handling which are presented in a standard format. The data collected and the computer programmes developed are set and in considerable detail as they are considered to be relevant to other fisheries.

It is hoped that the publication will be of value to banks and funding agencies in their investigation of the pre-investment phase of projects to improve the handling and utilization of small-pelagic species.

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ABSTRACT

The pre-investment studies described in this report are intended to assist in project identification in small pelagic fisheries, which have reached a suitable stage of technical development with FAO/DANIDA assistance. The studies are based on detailed technical analyses whose methods can be readily adapted to other small pelagic fisheries. In each case, the operational research leads directly to financial and economic analyses.

The results of the analyses have led to recommendations for each project that would assist the development process. A further positive recommendation relates to the use of the methodology and the techniques in fisheries in other countries.

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1. INTRODUCTION

A rational approach to fisheries development demands the efficient management of all resources and in particular investment capital. This investment process is concerned with implementing fisheries policy through a programme of projects that can be identified and also follow a cycle through to implementation and beyond. A universally accepted definition of a project is difficult but it is important to cover the wider range of activities and ensure that projects can be aggregated into national fisheries plans. A project could include surveys, civil works, fishing boats, plant, equipment but also institutional development, training, pricing policy, subsidies, and cost recovery. It is convenient to consider a project in several distinct stages commonly referred to as the project cycle and generally includes identification, preparation, appraisal, implementation and evaluation. The distinction between some of the stages can be difficult but the process is iterative and at each stage the same issues are considered repeatedly throughout the project cycle with varying degrees of intensity.

This report is concerned with the first phase of the cycle; identification of fishery project ideas that represent a high priority use of resources and also meet a test of feasibility with some assurance of technical, financial and economic solutions. Projects originate from a multiplicity of sources and in fisheries ideas must emanate from the pursuit of national objectives and, at the same time, there must be a grass roots desire to adopt and implement the project. The projects described in this report have several common strands:

(i) they are all concerned with re-habilitation, i.e., marginal improvements in existing fisheries rather than new investment projects;

(ii) they arise from the pursuit of national objectives with respect to food production;

(iii) they are influenced by the waste or underutilization of the fishery resource;

(iv) they result from the constraints in the development process created by a shortage of facilities in the marketing chain for adequate fish processing and storage;

(v) in some cases they complement initiatives taken by entrepreneurs to exploit the fisheries.

However, in all cases, these projects are related to the programming activities of bilateral and multilateral agencies and their ongoing projects in the respective countries.

The Fisheries Division of FAO has carried out, with the financial assistance of the Danish International Development Authority (DANIDA), an extensive programme of work to improve the effectiveness and efficiency of the utilization of small pelagic species for human consumption. The success of this programme has resulted in technological improvements in the handling, holding, distribution and marketing of these species. The motivation for progression of this programme will be enhanced if these technological improvements can be incorporated into a set of projects that can make a positive contribution to the economic development of the countries concerned.

The next stage of this work is therefore to prepare the projects to a point where they have passed the identification "test" and be ready for detailed preparation.

1.1 Objectives

The objective of the FAO/DANIDA programme has been defined: "To develop and introduce methods capable of handling large volumes of small pelagic fish as suitable material for the production of low cost products to benefit needy populations in developing countries". The preparation of pre-feasibility or pre-investment studies will assist further in identifying the financial and economic benefits and constraints that relate to the overall objectives and they will give an indication of funding required and the return on investment. The objective of the present study is to prepare such studies for selected fisheries in four countries:

(i) the Bali Strait fishery of Indonesia;

(ii) the Karnataka State fishery of India;

(iii) the Gulf of Thailand fishery;

(iv) the Morocco sardine fishery.

1.2 Source of Data

The data for the investment profiles have been obtained from several sources:

(i) observations, information, data and reports obtained from visits to the relevant fisheries of Indonesia, India, Thailand and Morocco;

(ii) a project visit to Rome to research the reports, information and data available in the Fisheries Division and the Investment Centre;

(iii) documents, reports, data and information from some of the major institutions of the countries concerned, and also FAO and FAO/DANIDA projects.

1.3 Recommendations

This project contains recommendations for consideration by aid and financial institutions relating to the fisheries development projects for each of the countries concerned. The recommendations cover feasibility, finance and the potential for further development projects. They also, either support the passage of these projects through the implementation stage or, assist in reducing areas of excessive risk.

2. ADDITIONAL PROJECT IMPETUS

The subject of investment identification was covered within the text of the programmes of action adopted by the FAO World Conference on Fisheries Management and Development with Programme 1 covering the planning, management and development of fisheries. The appropriate paragraphs for the project are:

(i) one of the objectives of the Programme will be to advise governments on investment in fisheries. Experience shows that much investment in fisheries has been misdirected, increasing the exploitation of resources that are already becoming heavily fished, while other more productive areas of investment have been neglected. Additional investment on the catching side has to be undertaken very selectively and carefully, especially where a new industrial fishery may compete with existing small-scale fisheries. Opportunities for investment in catching capacity exist where coastal States have decided to replace foreign fishing vessels by a national fleet. The greatest needs for investment in such cases appear to be in the development of infrastructure facilities and of better methods of processing and distribution which will increase the benefits from a fixed volume of catch;

(ii) the emphasis of this element of the Programme will be on a better use of investment funds. This requires a multi-disciplinary approach, based on the results of planning missions and, where appropriate, pilot development projects, which should be undertaken in close collaboration between FAO, with its full range of technical expertise, and the various international banks and other funding agencies. It is desirable that this collaboration start at the earliest stage of investment identification, and that technical assistance and investment work in harmony through all the subsequent stages of development, including such technical

matters as appropriate technology for vessels, gear, processing and distribution. Investment plans should be an integral part of fishery development planning process.

3. SMALL PELAGIC FISHERIES

3.1 General Characteristics

The species groups have been identified in many FAO reports and sardine-like species, herrings, pilchards and mackerels provide the major supply. They are caught by a wide range of fishing gears from the traditional to modern methods of high technology and are characterized by their abundance and seasonality. This leads to specific problems as these small fish are more susceptible to physical damage than large ones and thus accelerated spoilage. Careful handling and adequate preservation techniques are necessary to maintain a good quality level if the fish are marketed for human consumption.

Fishing operations have received considerable attention and investment but the problems of handling, processing and marketing large quantities of small pelagic species have often been ignored with the result that the fish meal industry has provided the main marketing outlet for a large number of these fisheries. If this situation is to be redressed then there is a great need for investment to be applied throughout the marketing chain.

3.2 The Requirements for Investment

If the premise that an expansion of markets for small pelagic species can be achieved through improvements in quality and by a reduction in wastage is accepted, then, the concept of a marketing chain that commences at sea on board the fishing vessel and ends with the consumer is appropriate for the investigation of investment projects.

The solutions for each fishery will be different and depend upon the following:

(i) the availability of fish resources;

(ii) population and its urban-rural distribution;

(iii) consumption behaviour in domestic markets;

(iv) export potential;

(v) infrastructure and current productive capacity.

The universal and over-riding practical requirement is to chill the fish immediately it comes on board, and ideally the fish should be held in chilled sea water (CSW) if strict quality control is to be maintained. There is considerable potential for investment if vessels can be converted to CSW storage or if new vessel designs can incorporate this facility. However, if good quality is to be maintained throughout the marketing chain, some investment in infrastructure might be desirable in order to remove flow constraints and improve quality. Again, the use of CSW storage is ideal, but where this is not possible then ice can be used as an alternative. A further area requiring investment is the distribution network with its insulated trucks and chill-stores.

If projects incorporating these investments are to be successful, it is important that changes in technology are compatible with the prevailing development situation in the country concerned. It is also essential that the value-added to the fish results in a situation where marginal earnings are commensurate with costs.

4. METHODOLOGY

4.1 Approach

The approach is concerned with a methodology for management decision-making in small pelagic fisheries and the use of techniques, criteria and data in such a way as to present solutions for the rational, financial and economic management of capital investment. This approach commences with an investigation of the operating characteristics of each of the fisheries. Operational analysis is then used to take proper account of factors which govern the ways a particular fishery system will respond to proposed improvements. The outcome from the operational analysis forms the best possible basis for calculating financial and economic results, which are expressed in a form suitable for presentation to an Investment Centre, International Bank or Aid Agency.

4.2 Techniques

The basic technique for this investment appraisal work is the computer model. In each case for the countries considered, linked models combine to represent vertically integrated operations throughout the marketing chain, i.e., from fishing operations through to sales.

For rapid programme development, and ease of investigating alternative assumptions, the computer models take the form of modular spreadsheets written in Multiplan on an Apple MacIntosh microcomputer. Just as the marketing chain extends from fishing activities through processing to distribution, so the chain of spreadsheet modules

represents them, with links provided for automatic transfer of information. Within the modules, very efficient analytical mechanisms are provided to calculate, e.g., the utilization of processing or transport capacity under both seasonal and random daily variation in supply. The effects of buffer storage are explicitly examined under the same conditions. When it is necessary to determine an optimal value, such as the best number of trucks to purchase, this is found automatically by iterative solution. In short, the computer models provide realistic operational analyses using the full power of the spreadsheet technique. Further information is given in Appendix 1.

4.3 Criteria

(i) Financial Rate of Return

The cash flow estimates, apart from expressing the financial liquidity of the project, form the basis for the calculation of the financial profitability. This, in turn, is used to measure the absolute (whether to reject or accept a project), as well as the relative (whether Project A is better than Project B, etc.) profitability of a project. The most commonly used indicator of financial profitability used by international development banks is the financial rate of return. This is the rate at which the present value (this calculation implies use of a discounting technique which takes into account that a unit of money earned in the future is worth less than a unit of money earned today) of future operational cash surpluses equals the cost of the investment. When a project is said to have a return of, for example, 20%, it usually means that the average earning power of the money used over the project's life period is 20%. This is the same as saying that the project could afford to pay up to 20% interest on capital (if all capital required were borrowed) and still break even.

(ii) Economic Rate of Return

The same discounting cash flow technique that is used for the Financial Rate of Return can also be used to calculate the return to the national economy of a project. While the financial calculations are based on prices of goods and services on the open market, economic calculations are (at least in principle) based on social opportunity costs (or the value to the economy of employing a unit of a certain resource in the best alternative usage). In developed and diversified economies with almost perfect competition, market prices usually do not differ much from the social opportunity costs. In developing economies, however, "imperfections" in the market (price controls, monopoly elements, import restrictions, minimum wage laws, subsidies in credit systems, etc.) tend to make market prices less suitable as guides for resource allocation. This tendency is also aggravated by

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the custom of levying taxes on certain goods. These taxes are measures used by the governments to transfer resources from one sector of the economy to another. To overcome the deficiencies of market prices in relation to allocation of capital resources for development purposes, some central planning agencies and development banks have introduced the concept of "shadow prices" in project evaluation.

The calculation of shadow prices is a cumbersome and costly undertaking. Therefore, for typical fisheries projects it is hardly worthwhile going into the process of producing shadow prices of most of the goods and services employed. For the calculation of Economic Rate of Return it is usually sufficient to use market prices and make the following adjustments:

(a) deduct government taxes and duties included in market prices for major cost items (vessels, gear, plant machinery, fuel, electricity, etc.);

(b) add subsidies paid by the government to promote fish consumption (consumer price subsidies, subsidies for ice production, subsidies for inland transportation, etc.);

(c) recalculate the cost of imported goods and revenues of exported goods;

(d) recalculate the cost of capital;

(e) while it is often maintained that shadow prices should be employed for labour used in fishery projects, there seem to be widely differing opinions on how to construct these prices. The argument that the labour costs should be zero, which implies that the value of the alternative production is nil, does not seem to coincide well with the conditions of such projects, which are dependent upon the availability of trained personnel (skippers, engineers, service staff, accountants, etc.). It appears that from the comparatively few cases where shadow prices for labour have been employed in fisheries projects, these shadow prices have been applied only for the unskilled personnel and at rates somewhat lower than the going wage rate.

(iii) Sensitivity Analysis

Fisheries projects, particularly those in pelagic fisheries, are by their nature subject to a high degree of uncertainty in the estimate of basic information such as catch rates, prices, etc. The data used in the financial and economic analyses are the best or most likely estimates of these important variables. It is very important

to know what effect departures from these values will have on the project. Sensitivity analysis provides a method that will give a guide in this area. The method is simply to recalculate the rates of return using changed values for the parameters whose sensitivity are important for the project. In the analyses in this report, the use of Switching Values automatically provides this facility in the case of Revenue, Operating Costs, and Investment Cost. A Switching Value is simply the percentage change in one of these factors which will reduce the rate of return to a point at which an investor might switch his attention to a standard safe alternative, e.g., a bank deposit at 10 per cent per year interest. When determining a switching value on one of three factors, the other two remain unchanged.

5. THE BALI STRAIT FISHERY

5.1 Background

The Indian oil sardine (Sardinella longiceps) is the major fishery in the Bali Strait and contributes about 80% of the total fish landings in this area. The fishery has expanded to a fleet of 300 fishing units with 190 based at Muncar, East Java. The most commonly used gear is the purse seine, introduced in 1970.

The installation of chilled sea water (CSW) was introduced in 1983 on board some of the vessels, and currently 69 purse seiners have been fitted with CSW tanks.

Sardine quality from traditional vessels varies considerably, especially if a fishing trip has to be extended, and the market price is very sensitive to quality. Auction prices can vary between Rp 50 and 200 per kilogramme. The provision of insulated fish holds for chilled sea water handling on board purse seiners has improved the quality of sardine considerably, thus commanding the higher prices and setting the standards for the canneries.

The location of fishing operations changes throughout the year, involving some longer trips with landings in Bali and transshipment by road to Muncar. The use of CSW during this period allows retention of good quality.

Good quality sardines are usually canned, medium quality used for boiled salted products (pindang), and poor quality converted into dry salted fish or meal.

In Muncar and its vicinity there are 6 canneries, 50 pindang units, 60 dry-salt fish producers and 6 fish meal plants. There are also 3 canneries and some fish processors on Bali.

The oil sardine is very important to the economy of the area, employing about 40% of the local people.

5.2 Technological Development

Installation of CSW tanks on board purse seiners has increased the quality and yield of oil sardines. There is evidence of additional demand, at high price levels, for more oil sardine so the objective for further technological development is to increase the high quality supply and enhance the incomes to fishermen.

The introduction of CSW technology has taken place at a rapid rate since its introduction, i.e., 69 vessels in three years. The tank installations on traditional vessels have varied in accordance with several factors, but the motivation and finance have been readily available. At the current rate of development, an accelerated programme of conversions by the provision of external finance appears to be inappropriate.

The technological need for the future is to incorporate CSW facilities within an efficient new vessel design that can be used as a replacement for the older traditional vessels reaching the end of their life.

5.3 The Pre-feasibility Study

This study assumes that the level of fishing effort cannot be increased by expanding the fleet and therefore the way forward is to replace old traditional vessels leaving the fleet with new CSW vessels.

The official statistics of 190 fishing units and a total catch of 10 000 t are incompatible with the quoted number of trips and seasonal catch rates. An examination of limited statistics suggested that the number of active units is about 120 and the total catch is nearer 15 000 t per year. On this basis, the number of trips per year is around 60 for traditional fishing units and for the 69 units converted to CSW storage probably 90 trips per year.

The investment profile takes 120 units as the base and assumes replacements of 5 new CSW vessels per year over a ten-year period. Such a development programme results in an increase in landings from 15 000 t to around 17 000 t per year over the period involved, whereas without replacement, the fleet would decrease to 70 active units with a reduction in landings from 15 000 t to 10 500 t per year.

The benefits that would be gained from the development programme have been calculated on the potential increase of sardine supplies to the canneries, rising from 74% of current catch to 99% of future catch.

Recent investment in cold storage in Muncar will bring the total available capacity to at least 1 000 t and this will be adequate. There is also sufficient chill store, over 40 t, obviating the need for CSW storage on shore. Freezing capacity of 30 t per day has recently been installed. Ice is currently delivered by truck and although there is a local demand for ice, the project can be contemplated without investment in a local ice plant.

5.4 Financial Analysis

The project provides 50 new vessels incorporating CSW storage as a basic design feature rather than add-on tanks over a ten-year period. These are replacement vessels at a total cost of Rp 850 million. It is assumed that loans could be secured at 12% interest over 10 years with a 3-year grace period on capital and interest repayments.

Financial analysis shows that the project, based on the assumptions for prices and inputs, is financially viable with an internal rate of return (FIRR) estimated at 25.6%. The repayment of loans does not present any difficulty and the sensitivity analysis indicates that the FIRR is more sensitive to variations of revenues than either investment or operating costs.

5.5 Economic Analysis

The economic analysis is based on financial data modified in the following way:

(i) prices for capital goods have been adjusted by a factor of 90% to exclude the estimated duty and tax component;

(ii) no adjustments have been made for foreign exchange as the current rate of exchange for the rupiah against the US dollar reflects the true value of the rupiah;

(iii) the price for diesel oil has been adjusted by a factor of 80% to eliminate duty;

(iv) licence fees and levies have been eliminated;

(v) this investment will not change the level of employment on vessels significantly and also does not allow for a change in the porterage system. There should be a marginal increase on shore in the processing sector but the cost of labour has not been adjusted.

The economic internal rate of return (EIRR) for the project investment is estimated at 38.8%. A 10% reduction in benefits would reduce the EIRR to 17.6% while a 10% overrun in investment cost would reduce the rate to 34.3%.

Over the period of the investment, there will be additional benefits as there will be an increase in the supply of fish. This will give additional benefits to fishermen and these will be enhanced by an increase in prices. The increase in the proportion of supply to the canneries will give a higher value-added and additional employment in the processing sector.

5.6 Conclusions

This is a classic case for a fishery where there is a statistical incompatibility between the number of boats, the catch rates, the fishing time and the total catch. The baseline data represent the best estimates that can be obtained from this fishery but they are to some extent speculative. The evidence is that the total catch is near its upper limit and any increase would be marginal. The analyses show reasonable financial and economic rates of return and the actual investment in the fishery supports positive values. This investment has resulted in CSW conversions rather than in increased fishing effort and this appears to be a national trend that will continue.

The limit on the total catch does mean that the primary objective of providing large volumes of low cost fishery products from this fishery is not attainable but employment can be maintained at a high level and probably be increased beyond the current 40% contribution. There can also be an improved contribution to GNP and some import saving from increases in supply to the canneries where the owners are confident of improved market potential. Increased supplies to the canneries imply a reduction in the supply of pindang but this could be alleviated by a re-allocation of fish destined for the fish meal plant. However, this has not been incorporated into the analysis as this would involve undue speculation.

This pre-feasibility study is dependent upon some assumptions that need verification before the project identification phase can be regarded as complete. Progress is possible in this fishery by investment in a pilot scheme to introduce a fishing vessel with CSW storage as an integral feature of the basic design. This would allow an investigation of the areas of greatest risk for the project and prove the assumption that the rates of return are robust with respect to the continuance of the total project.

5.7 Brief Description of Analysis Tables for Bali Strait

Financial Unit = Rp 1 million

Analysis Table	Description
5.1	Purse-seine units; differences in costs and operations between a traditional unit and one using CSW stowage.
5.2 and 5.3	The operational effects of an investment programme replacing 5 traditional purse-seine units/year with new standard design CSW units.
5.4	Details of canning and freezing capacity utilization for year 10 (this is repeated for all years) to produce overall capacity and raw material utilization estimates shown in analysis 5.2
5.5 to 5.7	As 5.2 to 5.4, but with no investment: fleet reduces by 5 traditional units/year.
5.8	Financial and economic analyses of incremental costs and benefits, with sensitivity analyses.

Bali Strait Purse Seine Unit		each	Traditional Units	Units with CSW
Capital costs	number	Rp. million	Rp. million	Rp. million
Golekan boats;13x3.25x1.5m	2	3.000	6.000	6.000
Diesel engines; 15.5 - 20 hp	4	1.500	6.000	6.000
Set of purse seine net	1	3.500	3.500	3.500
CSW fish hold	1			1.500
total			15.500	17.000
Maintenance costs				
Boats	15%		0.900	0.900
Engines	20%		1.200	1.200
Net	30%		1.050	1.050
CSW fish hold	30%			0.450
total			3.150	3.600
Running costs/trip		@ Rp	Rp'000	Rp'000
Diesel (litres)	150	250	37.5	37.5
Lubricants			1.8	1.8
Kerosene (litres)	5	200	1.0	1.0
Miscellaneous			7.5	7.5
Ice (blocks)	22	650		14.0
total			47.8	61.8
Number of trips/year			60	90
Other costs				
Levy	5.0%	revenue		
Crew savings	1.5%	revenue		
Transport	250	Rp/30kg		
Special fund	500	Rp/tonne		
Equipment transport	120	Rp'000		
Thanksgiving	120	Rp'000		
Licence, etc	20	Rp'000		
Proportion of sardine suitable for canning			10%	100%
Units leaving fleet/year through natural wastage			5	

Development programme

Year	1	2	3	4	5	6	7	8	9	10
New CSW holds										
Replacement boats	5	5	5	5	5	5	5	5	5	5
New freezing capacity; t/day	30									
Replacement boats (with CSW)										
Number of active units: CSW	74	79	84	89	94	99	104	109	114	119
non-CSW	46	41	36	31	26	21	16	11	6	1
total	120	120	120	120	120	120	120	120	120	120
Sardine suitable for canning	74%	77%	80%	83%	86%	89%	92%	94%	97%	99%
Canning capacity; t/day	120	120	120	120	120	120	120	120	120	120
Freezing capacity; t/day	30	30	30	30	30	30	30	30	30	30
Total landings, tonnes	15243	15485	15728	15971	16214	16456	16699	16942	17184	17427
Sardine; tonnes	13051	13259	13467	13675	13883	14090	14298	14506	14714	14922
Mackerel, Tuna; tonnes	152	155	157	160	162	165	167	169	172	174
Other; tonnes	2039	2071	2104	2136	2169	2201	2234	2266	2299	2331
Utilisation of landings; tonnes										
Sardine; canned	8980	9412	9824	10227	10611	10986	11344	11692	12027	12354
Sardine; frozen	175	205	239	270	305	338	373	408	444	476
Sardine; traditional proc.	3117	2913	2723	2542	2373	2213	2065	1925	1794	1673
Mackerel/tuna; pindang	152	155	157	160	162	165	167	169	172	174
Other; traditional	1631	1657	1683	1709	1735	1761	1787	1813	1839	1865
Fish meal	1187	1143	1101	1063	1027	994	963	935	908	885
Average prices; Rp/kg										
Sardine; canned	200	200	200	200	200	200	200	200	200	200
Sardine; frozen	200	200	200	200	200	200	200	200	200	200
Sardine; traditional proc.	60	60	60	60	60	60	60	60	60	60
Mackerel/tuna; pindang	300	300	300	300	300	300	300	300	300	300
Other; traditional	70	70	70	70	70	70	70	70	70	70
Fish meal	40	40	40	40	40	40	40	40	40	40

Year	1	2	3	4	5	6	7	8	9	10
Revenue; Rp million										
Sardine; canned	1796.0	1882.5	1964.9	2045.4	2122.1	2197.2	2268.9	2338.3	2405.4	2470.9
Sardine; frozen	35.[illegible]	41.0	[illegible]7.8	54.1	61.1	67.6	74.5	81.5	88.8	95.2
[illegible]ardine; traditional proc.	187.0	174.8	163.4	152.5	142.4	132.8	123.9	115.5	107.7	100.4
Mackerel/tuna; pindang	45.7	46.5	47.2	47.9	48.6	49.4	50.1	50.8	51.6	52.3
Other; traditional	114.2	[illegible]16.0	117.8	119.6	121.5	123.3	125.1	126.9	128.7	130.5
Fish meal	47.5	45.7	44.1	42.5	41.1	39.7	38.5	37.4	36.3	35.4
total	2225.4	2306.4	2385.2	2462.1	2536.8	2609.9	2681.0	2750.5	2818.5	2884.7
Operating costs										
Maintenance	411.3	413.6	415.8	418.1	420.3	422.6	424.8	427.1	429.3	431.6
Trips	543.7	557.2	570.6	584.1	597.6	611.1	624.6	638.0	651.5	665.0
Other	279.6	287.0	294.2	301.4	308.4	315.3	322.0	328.7	335.3	341.7
sub-total	1234.5	1257.7	1280.7	1303.5	1326.3	1348.9	1371.4	1393.8	1416.1	1438.3
Crew share	495.5	524.4	552.2	579.3	605.2	630.5	654.8	678.4	701.2	723.2
total	1730	1782.1	1832.9	1882.8	1931.5	1979.4	2026.2	2072.1	2117.3	2161.5
Investment costs										
New CSW holds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Replacement boats	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
New freezing capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0

Bali Strait Purse-seiners, Canning and Freezing

Analysis Table
5.4

Monthly analysis for year 10

Month (not in time sequence)	1	2	3	4	5	6	7	8	9	10	11	12	total
Season	low	low	low	med	med	med	med	med	med	peak	peak	peak	
Total landings;tonnes	62.2	194.5	340.0	501.6	683.7	891.7	1135.0	1427.5	1794.3	2287.8	3047.8	5061.0	17427
Sardine; tonnes	43.6	136.1	238.0	401.2	546.9	713.4	908.0	1142.0	1435.4	2059.1	2743.1	4554.9	14922
Mackerel, Tuna; tonnes	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	174
Other; tonnes	4.1	43.8	87.5	85.8	122.2	163.8	212.5	271.0	344.3	214.3	290.3	491.6	2331
Number of days shore operation	14	15	16	17	18	20	20	22	23	24	25	26	240
Average daily landings													
Sardine; tonnes	3.1	9.1	14.9	23.6	30.4	35.7	45.4	51.9	62.4	85.8	109.7	175.2	
Mackerel, Tuna; tonnes	1.0	1.0	0.9	0.9	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.6	
Other; tonnes	0.3	2.9	5.5	5.0	6.8	8.2	10.6	12.3	15.0	8.9	11.6	18.9	
Canning capacity, total;t/day	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
Freezing capacity t/day	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	
Sardine processing; good quality only													
Average supply; t/day	3.1	9.0	14.8	23.5	30.2	35.5	45.2	51.6	62.1	85.4	109.2	174.3	
Average canned; t/day	3.1	9.0	14.8	23.5	30.1	35.2	45.1	51.4	61.0	78.6	90.1	104.5	
Average frozen; t/day	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.2	0.8	4.3	9.5	18.8	
Total canned; tonnes	43.3	135.5	236.8	399.2	542.6	704.5	901.6	1130.2	1403.8	1086.1	2253.7	2717.1	12354
Total frozen; tonnes	0.0	0.0	0.0	0.0	1.0	2.8	1.1	3.2	11.4	60.2	133.4	262.9	476

Development programme

Year	1	2	3	4	5	6	7	8	9	10
New CSW holds										
Replacement boats	0	0	0	0	0	0	0	0	0	0
New freezing capacity; t/day	30									
Replacement boats (with CSW)										
Number of active units: CSW	69	69	69	69	69	69	69	69	69	69
non-CSW	46	41	36	31	26	21	16	11	6	1
total	115	110	105	100	95	90	85	80	75	70
Sardine suitable for canning	72%	74%	77%	79%	82%	85%	88%	91%	95%	99%
Canning capacity; t/day	120	120	120	120	120	120	120	120	120	120
Freezing capacity; t/day	30	30	30	30	30	30	30	30	30	30
Total landings, tonnes	15000	14498	13997	13495	12993	12492	11990	11488	10987	10485
Sardine; tonnes	12844	12414	11984	11555	11125	10696	10266	9837	9407	8978
Mackerel, Tuna; tonnes	150	145	140	135	130	125	120	115	110	105
Other; tonnes	2006	1939	1872	1805	1738	1671	1604	1537	1470	1403
Utilisation of landings; tonnes										
Sardine; canned	8736	8702	8669	8635	8602	8568	8535	8501	8467	8433
Sardine; frozen	158	156	154	152	150	148	146	143	141	139
Sardine; traditional proc.	3160	2845	2529	2214	1899	1584	1269	954	639	324
Mackerel/tuna; pindang	150	145	140	135	130	125	120	115	110	105
Other; traditional	1605	1552	1498	1444	1390	1337	1283	1229	1176	1122
Fish meal	1191	1099	1007	914	822	730	638	546	454	362
Average prices; Rp/kg										
Sardine; canned	200	200	200	200	200	200	200	200	200	200
Sardine; frozen	200	200	200	200	200	200	200	200	200	200
Sardine; traditional proc.	60	60	60	60	60	60	60	60	60	60
Mackerel/tuna; pindang	300	300	300	300	300	300	300	300	300	300
Other; traditional	70	70	70	70	70	70	70	70	70	70
Fish meal	40	40	40	40	40	40	40	40	40	40

Bali Strait, Zero Investment

Analysis Table
5.6

Year	1	2	3	4	5	6	7	8	9	10
Revenue; Rp million										
Sardine; canned	1747.2	1740.5	1733.8	1727.1	1720.4	1713.7	1706.9	1700.1	1693.4	1686.6
Sardine; frozen	31.5	31.2	30.8	30.4	30.0	29.6	29.1	28.7	28.3	27.8
Sardine; traditional proc.	189.6	170.7	151.8	132.8	113.9	95.0	76.1	57.2	38.4	19.5
Mackerel/tuna; pindang	45.0	43.5	42.0	40.5	39.0	37.5	36.0	34.5	33.0	31.5
Other; traditional	112.4	108.6	104.8	101.1	97.3	93.6	89.8	86.1	82.3	78.5
Fish meal	47.7	44.0	40.3	36.6	32.9	29.2	25.5	21.8	18.1	14.5
total	2173.3	2138.4	2103.4	2068.5	2033.5	1998.5	1963.5	1928.4	1893.4	1858.3
Operating costs										
Maintenance	393.3	377.6	361.8	346.1	330.3	314.6	298.8	283.1	267.3	251.6
Trips	518.8	504.4	490.1	475.7	461.4	447.1	432.7	418.4	404.0	389.7
Other	274.0	267.3	260.6	253.9	247.2	240.5	233.8	227.1	220.4	213.7
sub-total	1186.1	1149.3	1112.5	1075.7	1038.9	1002.1	965.3	928.5	891.7	854.9
Crew share	493.6	494.5	495.5	496.4	497.3	498.2	499.1	500.0	500.8	501.7
total	1679.7	1643.8	1608	1572.1	1536.2	1500.3	1464.4	1428.5	1392.6	1356.6
Investment costs										
New CSW holds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Replacement boats	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New freezing capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Monthly analysis for year 10

Month (not in time sequence)	1	2	3	4	5	6	7	8	9	10	11	12	total
Season	low	low	low	med	med	med	med	med	med	peak	peak	peak	
Total landings;tonnes	37.4	117.0	204.6	301.8	411.3	536.5	682.9	858.8	1079.5	1376.5	1833.7	3044.9	10485
Sardine; tonnes	26.2	81.9	143.2	241.4	329.1	429.2	546.3	687.1	863.6	1238.8	1650.3	2740.4	8978
Mackerel, Tuna; tonnes	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	105
Other; tonnes	2.5	26.4	52.6	51.6	73.5	98.6	127.8	163.0	207.2	128.9	174.6	295.8	1403
Number of days shore operation	14	15	16	17	18	20	20	22	23	24	25	26	240
Average daily landings													
Sardine; tonnes	1.9	5.5	8.9	14.2	18.3	21.5	27.3	31.2	37.5	51.6	66.0	105.4	
Mackerel, Tuna; tonnes	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.3	
Other; tonnes	0.2	1.8	3.3	3.0	4.1	4.9	6.4	7.4	9.0	5.4	7.0	11.4	
Canning capacity, total;t/day	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
Freezing capacity t/day	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	
Sardine processing; good quality only													
Average supply; t/day	1.9	5.4	8.9	14.1	18.1	21.3	27.1	31.0	37.2	51.2	65.4	104.5	
Average canned; t/day	1.9	5.4	8.9	14.1	18.1	21.3	27.1	31.0	37.2	50.9	63.9	88.2	
Average frozen; t/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.1	8.6	
Total canned; tonnes	26.0	81.2	142.0	239.3	326.2	425.5	541.6	681.1	855.9	1222.0	1598.5	2293.7	8433
Total frozen; tonnes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	3.0	15.7	120.3	139

Summary : Bali Strait Project

Analysis Table 5.8

Year	1	2	3	4	5	6	7	8	9	10
1. Cash Inflow										
Fleet revenue with investments	2225	2306	2385	2462	2537	2610	2681	2751	2818	2885
without	2173	2138	2103	2068	2034	1999	1963	1928	1893	1858
Incremental revenue	52	168	282	394	503	611	718	822	925	1026
Total Inflow	52	168	282	394	503	611	718	822	925	1026
2. Cash Outflow										
Op cost with investments	1730	1782	1833	1883	1932	1979	2026	2072	2117	2161
without	1680	1644	1608	1572	1536	1500	1464	1428	1393	1357
Sub-total Operating cost	50	138	225	311	395	479	562	644	725	805
Investment Cost										
New CSW holds	0	0	0	0	0	0	0	0	0	0
Replacement boats	85	85	85	85	85	85	85	85	85	-298
New freezing capacity	0	0	0	0	0	0	0	0	0	0
Total Investment	85	85	85	85	85	85	85	85	85	-298
Total Outflow	135	223	310	396	480	564	647	729	810	507
3. Net Benefit Before Financing	-83	-55	-28	-2	23	47	71	93	115	519
Financing (indicative example)										
Loan	283	283	283							
Borrower's Contribution	0	0	0							
Repayment on Principal	0	0	0	22	47	74	83	93	104	117
Interest Payment	0	0	0	46	90	131	122	112	101	88
Net Financing	283	283	283	-68	-136	-205	-205	-205	-205	-205
Net Cash Flow; annual	200	228	255	-70	-114	-157	-134	-111	-89	314
cumulative	200	428	684	613	500	342	209	97	8	323

Internal Rate of Return — Financial: 25.6% — Economic: 38.8%

Sensitivity Analysis

Variations of :-	by :-	IRR	Switching Values at 10.0%	by :-	IRR	Switching Values at 10.0%
Investment Cost	10.0%	22.0%	60.3%	10.0%	34.3%	113.9%
Operating Cost	10.0%	10.0%	10.0%	10.0%	23.0%	17.9%
Revenue	-10.0%	5.7%	-7.9%	-10.0%	17.6%	-13.4%

6. THE KARNATAKA STATE FISHERY

6.1 Background

The State of Karnataka lies on the west coast of India and has a coastline of about 270 km with 145 marine fishing villages. The fishing season starts in September and although it finishes in May, about 70% of the catches will have been taken before the end of January. The important species are oil sardine (Sardinella longiceps) and mackerel (Rastrelliger kanagurta) and the activities of purse seiners are confined to those ports such as Mangalore, Malpe, Gangoli, and Karwar that have appropriate facilities such as berthing, transportation, ice plants, cold storage, oil and fresh water.

The indicators relating to the general health of this fishery are now giving cause for concern (Figures 1 and 2).

The supply situation is becoming increasingly difficult (Table 1) and the problems are accentuated by the increased rate of decline of catches of the more valuable mackerel relative to oil sardine. This reflects on the revenues returned to fishing boats and ultimately on the incomes of fishermen. This situation can be alleviated to some extent if the value of the catch can be raised by improved handling utilization and marketing.

Table 1

Karnataka purse-seine statistics, 1975-83

Year	Total catch (t)	Purse-seine catch (t)	Purse-seine boats (No.)	Average catch/boat (t)
1975/76	78 627	1 200	2	600
1976/77	62 785	10 340	20	517
1977/78	126 726	30 551	52	588
1978/79	166 995	111 788	171	654
1979/80	191 026	124 989	230	543
1980/81	160 703	96 320	260	370
1981/82	145 377	97 217	300	324
1982/83	104 055	56 799	348	163

Source: Government of Karnataka Statistical Bulletin of Fisheries 1982-83. Issued by Directorate of Fisheries, Bangalore 560001

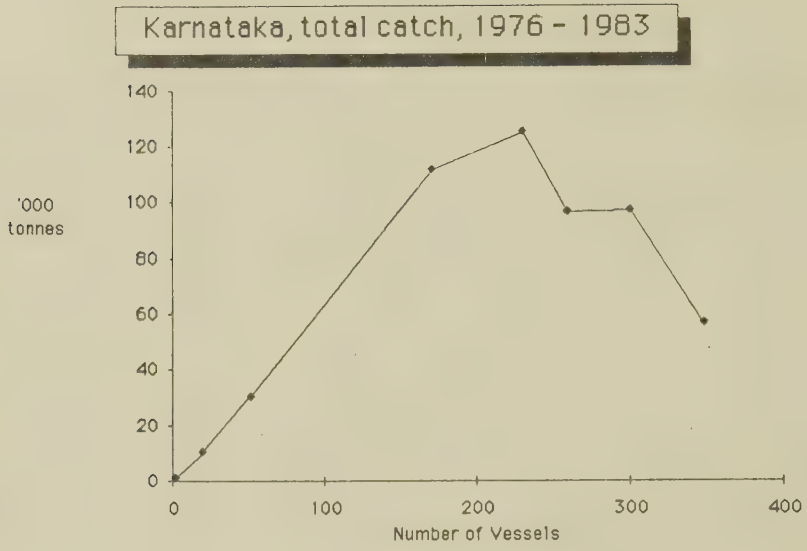

Figure 1 Karnataka total catch, 1976-83

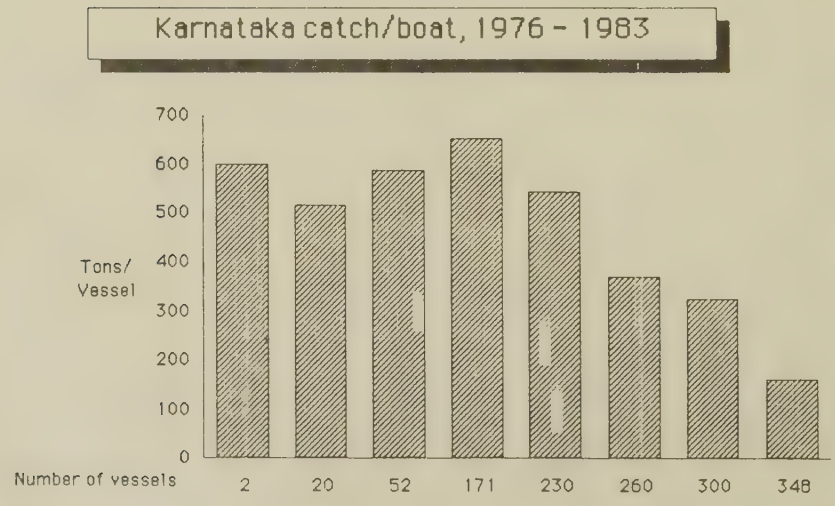

Figure 2 Karnataka catch/boat, 1976-83

The problem of transportation of fish from the ports to the markets needs careful consideration. Over long distances the problems are compounded by communication requirements and high costs. Bombay and Mangalore are about 800 km apart and cargoes such as timber, tiles and sand are transported in sailing craft or carrier vessels equipped with sail and engine. The transportation of fish from the Mangalore area to Bombay by sea is not a new idea. It was in vogue in the past but was discontinued about a decade ago as a consequence of competition from road transport.

6.2 Technological Development

The FAO/DANIDA project carried out trials with the use of chilled sea water (CSW) for holding and transporting mackerel and oil sardine on the Karnataka coast of India in October 1979 and March 1980. The results showed very distinctly an increase in the storage life of both species when chilled in CSW immediately after catching.

Trials also served to demonstrate the suitability of CSW as a transport medium over long distances (e.g., Mangalore-Bombay, approximately 800 km). Conclusions drawn were that by utilizing the increase in storage life it would be possible to increase the share used for human consumption and supply better quality fish to the markets. When landings of fish (in particular mackerel and oil sardine, but also other species) are larger than the market demand, the supply can be regulated by holding fish in CSW, preserving the fresh quality for several days. This would help to ensure high quality in the fresh fish market and even out fluctuations in supply. Similarly, it is possible to hold buffer stocks of high quality fish to facilitate an even production flow. Chilling fish in CSW immediately after catch and transporting it either in CSW containers or boxed in ice would greatly increase the supply radius of fresh fish and thereby the size of the potential market.

The objective of the project can be achieved in three different ways:

(i) to use the extended shelf life to smooth the fluctuating supply/demand problems and assist in maintaining prices and reduce wastage;

(ii) in the long term to attract a price premium for improved quality of fish;

(iii) to use the CSW facility as a buffer storage prior to freezing in periods of glut with a subsequent improvement in quality of frozen fish.

In 1982, a seminar was organized with the aim of bringing together all the parties involved in this fishery in order to

transform the positive results arising from the technological trials into a commercial reality.

The operations in the industry were subjected to several economic analyses but the most important proposal arising from the seminar was to invest in a commercial scale project integrating CSW - equipped purse seiners, onshore CSW buffer storage, feeding distant markets such as Bombay. Such distribution would require insulated trucks.

Later investigations have shown that conversion of the existing standard purse seiner to CSW hold cannot be recommended due to non-compliance with the IMCO (IMO) requirements.

6.3 The Pre-Feasibility Study

The introduction of additional purse seiners can only be justified on account of their greater range, flexibility or the possibility for them to extend the fishing season. This can only be achieved with fishing vessels designed with CSW storage holds. The on shore investment must have complementary facilities including CSW buffer storage and insulated trucks for onward distribution.

One of the major difficulties encountered in this project relates to the rapid decline of catch ratios (Figure 2) and under these circumstances it is difficult to secure reliable data.

The investment programme is relatively modest, i.e., 10 vessels over a period of three years, linked with CSW buffer storage on shore which in turn is included at a capacity not less than the daily transport capacity based on deliveries from Mangalore to Bombay.

The purse-seiners in the fishery at 13,7 m length and 102 hp are similar to those currently operating there, and, it has been assumed that they are experiencing similar catch rates.

6.4 Investment Analysis

The total investment package over a 10-year period includes 10 purse-seiners, 28 trucks and CSW onshore storage tanks at a total cost of 13 million rupees. It is assumed in the example that a loan could be secured at 10.25% over 10 years with a 2-year grace period on capital borrowed in years 1 and 2, and zero grace period on capital borrowed in year 3 and afterwards.

The financial analysis shows that this project, based on the assumptions for prices and inputs, is not financially sound with a low internal rate of return (FIRR) estimated at 6.5%. The FIRR is more sensitive to variations of revenues than investment or operating costs, and the risk for this project is high.

6.5 Economic Analysis

The economic analysis is based on financial data modified as follows:

(i) prices for capital goods have been adjusted by a factor of 80% to exclude the duty and tax component;

(ii) the operating costs are assumed to be without tax except for fuel cost which is rated at 20%;

(iii) to arrive at economic costs and revenues, a standard conversion factor of 80% has been applied to all local currency components;

(iv) no adjustments have been made for labour costs.

The economic internal rate of return (EIRR) for the project investment is estimated at 13.7%. A 10% reduction in revenues would eliminate any return, and a 10% overrun in investment cost would reduce the EIRR to 10.2%.

Additional benefits from this project could arise from investigations of resource potential adjacent to the current fishing area. There could also be additional employment creation, particularly on shore, and a greater availability of fish, about 5 000 t per year for transportation to distant markets such as Bombay.

6.6 Conclusions

The continual increase of effort in this fishery has created a situation whereby individual vessel catches have decreased to an unacceptable level and the pre-feasibility study shows a low profit situation. The project, as conceived should not go ahead.

The key question arising from this conclusion is whether or not development should go ahead. There are two positive aspects for further development of this fishery and the first relates to the objective to supply large quantities of low cost fish and fish products to needy people and this cannot be achieved without improved preservation and storage on fishing vessels. The second aspect is that exploration of the sea beyond the immediate coastal belt fished by the current fleet is highly desirable. The model used for the prefeasibility shows a potential profit for such an operation, albeit from speculative catch rates. This leads to a recommendation for the introduction of a purse seiner with CSW storage as an integral part of the basic design as a research and development project.

6.7 Brief Description of Analysis Tables for Karnataka

Financial Unit = 1.Rs 1 000

Analysis Table	Description
6.1 and 6.2	Proposed CSW purser; operational analysis of a single vessel.
6.3	Landings, costs and revenues resulting from an investment schedule for a new fleet of 10 pursers.
6.4	Costs for a 12 t insulated truck.
6.5	Operational analysis for inland distribution to Bombay of sardine and mackerel landings resulting from the fleet investment in 6.3. Calculates optimum number of trucks and utilisation of both landings and transport.
6.6	Financial and economic analyses of costs and benefits, with sensitivity analyses.

Inflation index, 1982 to 1985	1.15				
Length o/a	13.72 m				
Main engine power	102 hp				
Fuel consumption	0.18 kg/hp/h				
Steaming speed	7.2 kn				
Fuel capacity	1.94 tonnes				
Fishroom capacity	14.0 m^3				
Stowage rate	0.7 t/m^3				
Capital cost; boat with CSW hc	528 I.Rs'000				
nets	329 I.Rs'000				
total	857				
Depreciation period	10 yrs				
Annual depreciation	52.8 I.Rs'000				
Operating pattern					
Power used fishing(% of full)	40%				
Distance to fishing grounds	9.00 nm				
Steaming time to grounds	1.25 h				
Maximum fishing time	36.00 h				
Maximum trip duration	38.49 h				
Days at sea, year 1	150				
Annual trend, days at sea	-1.00%				
	mackerel	sardine	other	tot/ave	
Proportion of catch	18%	73%	9%	100%	
Catch rate on grounds, year 1	0.02	0.09	0.01	0.13	tonnes/hour
Annual trend, catch rate	-1.0%	-1.0%	-1.0%		
Sale price, Mangalore; year 1	2.9	1.3	1.3	1.46	I. Rs/kg
Annual trend, fish prices	0.0%	0.0%	0.0%		
Fuel cost price; year 1	3.96 I. Rs/kg				
Annual trend, fuel price	0.0%				
Ice price	145 I.Rs/tonne				

Karnataka Purser

Year	1	2	3	4	5	6	7	8	9	10
Days at sea	150.0	148.5	147.0	145.5	144.0	142.5	141.0	139.5	138.0	136.5
Catch rate; mackerel	0.023	0.023	0.023	0.023	0.022	0.022	0.022	0.022	0.021	0.021
sardine	0.095	0.094	0.093	0.092	0.091	0.090	0.089	0.088	0.087	0.086
other	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
total tonnes/hour	0.130	0.128	0.127	0.126	0.124	0.123	0.122	0.121	0.119	0.118
Catch/trip, all species; tonnes	4.67	4.62	4.57	4.53	4.48	4.43	4.39	4.34	4.29	4.25
Average fishing time/trip; h	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
Catch/trip, tonnes; mackerel	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.78	0.77	0.76
sardine	3.41	3.37	3.34	3.30	3.27	3.24	3.20	3.17	3.13	3.10
other	0.42	0.42	0.41	0.41	0.40	0.40	0.39	0.39	0.39	0.38
Average trip duration; days	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Average number of trips	75.0	74.3	73.5	72.8	72.0	71.3	70.5	69.8	69.0	68.3
Annual catch, tonnes; mackere	63.0	61.7	60.5	59.3	58.1	56.9	55.7	54.5	53.3	52.2
sardine	255.5	250.4	245.4	240.4	235.5	230.6	225.8	221.0	216.3	211.6
other	31.5	30.9	30.3	29.6	29.0	28.4	27.8	27.2	26.7	26.1
total	350.0	343.0	336.1	329.3	322.6	315.9	309.3	302.7	296.2	289.8
Revenue, I.Rs '000; mackerel	208	178	174	170	167	163	160	157	153	150
sardine	372	317	310	304	298	292	286	280	274	268
other	46	39	38	37	37	36	35	34	34	33
total	626	533	523	512	502	491	481	471	461	451
Operating costs, I.Rs '000										
Fuel	89	88	88	87	86	85	84	83	82	81
Lubricants	4	4	4	4	4	4	4	4	4	4
Repairs, maintenance	5	8	11	13	16	18	21	24	26	29
Nets and gear	329	0	0	329	0	0	329	0	0	329
Wages	188	160	157	154	150	147	144	141	138	135
Insurance	11	10	8	7	6	5	4	3	2	1
Harbour dues	4	4	4	4	4	4	4	4	4	4
Carrier Hire	0	0	0	0	0	0	0	0	0	0
Landing charges	12	12	12	11	11	11	11	10	10	10
Water	0	0	0	0	0	0	0	0	0	0
Ice	17	16	16	16	15	15	15	14	14	14
Total operating cost	659	303	299	625	293	290	616	284	281	608
Operating profit	-33	231	223	-113	208	201	-135	186	179	-157
Net benefit/purser	-561	231	223	-113	208	201	-135	186	179	-47

Karnataka Purser

Year	1	2	3	4	5	6	7	8	9	10
Project schedule										
Number of pursers purchased		3	3	4			0	0	0	0
Revenue		1877	3477	5671	5237	5131	5026	4922	4819	4717
Operating cost		1978	2886	4443	3985	3954	4252	3893	3863	4163
Investment cost	1584	1584	2111	0	0	0	0	0	0	-210
Depreciation		158	317	528	528	528	528	528	528	528
Shore operations; days/year	200									
Ave landed/day,tonnes; mackerel		0.95	1.87	3.09	3.03	2.97	2.91	2.85	2.79	2.73
sardine		3.83	7.59	12.55	12.30	12.05	11.80	11.55	11.31	11.07
other		0.40	0.78	1.29	1.25	1.21	1.17	1.14	1.10	1.07

12 ton truck			
Payload		8.00	tonnes
Round trip		5	days
Capital cost		322	I.Rs '000
Depreciation period		4	years
Operating costs/year; I.Rs '000			
		active	standby
Inter-state permit		12.65	12.65
Insurance, 6.5%		20.93	20.93
Road tax		8.05	8.05
Fuel		98.90	
Lubricants		9.89	
Maintenance, 15%		48.30	48.30
Driver		8.05	
Cleaner		5.75	
Travel allowance		3.45	
Ice		29.90	
	Total	245.87	89.93

Inland Distribution, Karnataka to Bombay

Analysis Table 6.5

Year	1	2	3	4	5	6	7	8	9	10
Shore operations; days/year	200									
Ave landed/day,tonnes; mackerel		0.95	1.87	3.09	3.03	2.97	2.91	2.85	2.79	2.73
sardine		3.83	7.59	12.55	12.30	12.05	11.80	11.55	11.31	11.07
other		0.40	0.78	1.29	1.25	1.21	1.17	1.14	1.10	1.07
Transport reqd/day; tonnes		4.78	9.46	15.64	15.33	15.02	14.71	14.40	14.10	13.80
Trucks/day; optimum calculated		1	2	2	2	2	2	2	2	2
Trucks/day; selected		1	2	2	2	2	2	2	2	2
Trucks required; active		5	10	10	10	10	10	10	10	10
Trucks required; standby		1	1	1	1	1	1	1	1	1
Number of trucks purchased		6	5	0	0	6	5	0	0	6
CSW buffer capacity required; tonnes		8	16	16	16	16	16	16	16	16
Ave transported/day to Bombay; tonnes		4.78	9.46	14.60	14.45	14.30	14.16	13.97	13.75	13.54
Assume mackerel 80%		0.76	1.50	2.48	2.43	2.38	2.33	2.28	2.23	2.18
sardine		4.02	7.96	12.13	12.03	11.93	11.83	11.69	11.52	11.35
Total transported/year,tonnes		955	1892	2921	2891	2861	2831	2795	2751	2708
Incremental prices; mackerel	2.88	I.Rs/kg	(Bombay v. Mangalore)							
sardine	1.04	I.Rs/kg								
Incremental revenue; mackerel		435	861	1423	1395	1366	1338	1311	1283	1256
sardine		832	1648	2511	2490	2469	2448	2421	2385	2350
total		1267	2509	3934	3884	3835	3787	3731	3668	3606
Operating cost, trucks		1319	2549	2549	2549	2549	2549	2549	2549	2549
CSW buffer		17	35	53	53	52	52	51	50	49
Investment cost, trucks		1932	1610	0	0	1932	1610	0	0	483
CSW buffer	152									
Depreciation, trucks		483	886	886	886	886	886	886	886	886

Karnataka Purser

Year	1	2	3	4	5	6	7	8	9	10
1. Cash Inflow										
Fleet revenue, Mangalore		1872	3477	5671	5237	5131	5026	4922	4819	4717
Incremental revenue, Bombay		1267	2509	3934	3884	3835	3787	3731	3668	3606
Total Inflow	0	3144	5986	9605	9122	8966	8813	8653	8487	8323
2. Cash Outflow										
Operating cost										
Fleet		1978	2886	4443	3985	3954	4252	3893	3863	4163
Trucks		1319	2549	2549	2549	2549	2549	2549	2549	2549
CSW buffer store		17	35	53	53	52	52	51	50	49
Sub-total Operating cost	0	3314	5469	7045	6586	6555	6852	6493	6462	6761
Investment Cost										
Fleet	1584	1584	2111	0	0	0	0	0	0	-210
Trucks		1932	1610	0	0	1932	1610	0	0	483
CSW buffer store	152									
Sub-total Investment Cost	1736	3516	3721	0	0	1932	1610	0	0	273
Total Outflow	1736	6830	9190	7045	6586	8487	8462	6493	6462	7034
3. Net Benefit Before Financi	-1736	-3685	-3204	2560	2535	480	350	2161	2025	1290
Financing (indicative example)										
Loan	4000	4000	0							
Borrower's Contribution	2500	2500	0							
Repayment on Principal	0	0	299	628	693	764	842	928	1023	1128
Interest Payment	0	0	494	958	893	822	744	658	562	457
Net Financing	6500	6500	-793	-1586	-1586	-1586	-1586	-1586	-1586	-1586
Net Cash Flow; annual	4765	2815	-3997	974	950	-1106	-1236	575	440	-296
cumulative	4765	7579	3583	4557	5507	4400	3165	3740	4179	3883

Internal Rate of Return Financial 6.5% Economic 13.7%

Sensitivity Analysis

Variations of -	by -	IRR at	Switching Values 10.0%	by -	IRR at	Switching V 10.0%
Investment Cost	10.0%	3.3%	-9.6%	10.0%	10.2%	10.7%
Operating Cost	10.0%	-9.0%	-2.9%	10.0%	3.1%	3.6%
Revenue	-1.0%	4.4%	2.2%	-10.0%	-1.5%	-2.6%

7. THE GULF OF THAILAND FISHERY

7.1 Background

Prior to the rapid development of trawl fisheries in 1962, annual catch of pelagic species accounted for a major portion of the total marine catch. The proportion of pelagic catch had decreased gradually and hit the lowest percentage (about 9% of the total marine catch) in 1972. However due to the introduction of the luring purse seine there was a substantial increase in annual landings of pelagic species in the Gulf. The share of pelagic catch increased significantly and reached the peak of about 28.5% of the total marine catch in 1977. In 1982 the total Gulf catch of small pelagics (herrings, sardines, anchovies, etc.) was approximately 116 500 t, and out of this total about 90 000 t were sardines.

The most important species were the mackerels (Rastrelliger brachysoma, R. kanagurta) but more recently sardines (Sardinella gibbosa, S. fimbriata) and roundscads (Decapterus spp.) have predominated.

Major fishing grounds for pelagic fisheries, except for luring purse-seine fisheries, are located mainly in the coastal waters of the Gulf of Thailand. The luring purse-seine fisheries are operated mainly in waters with the depth of more then 30 m.

The major fishing grounds are shown in Figures 3 and 4.

In the wooden purse seiners, the holds have a capacity of 40-50 t of fish, but are divided into 5-t compartments. The holds are insulated and crushed ice is used. The fish is iced in bulk and with ice meltage the storage system resembles CSW storage. However, the variability of the ratio of fish to ice is very high, giving a wide range in quality.

The catches, between 15 t and 20 t per trip, are lifted from the hold to the deck by scoop and emptied into bamboo baskets, which are unloaded by chute. The fish is then spread out for sorting on the ground and groups of women sort the fish according to species and size. The fish is then weighed in bamboo baskets and sold to merchants in the baskets or after repacking with ice on open trucks in wooden boxes.

7.2 Technological Development

The initial efforts for quality improvement within the FAO/DANIDA project were concentrated upon the unloading and sorting of purse-seine catches. The problems of the current system and its effect on quality and yield are clear. Improvements were attempted by the introduction of an unloading conveyor and mechanical sorting

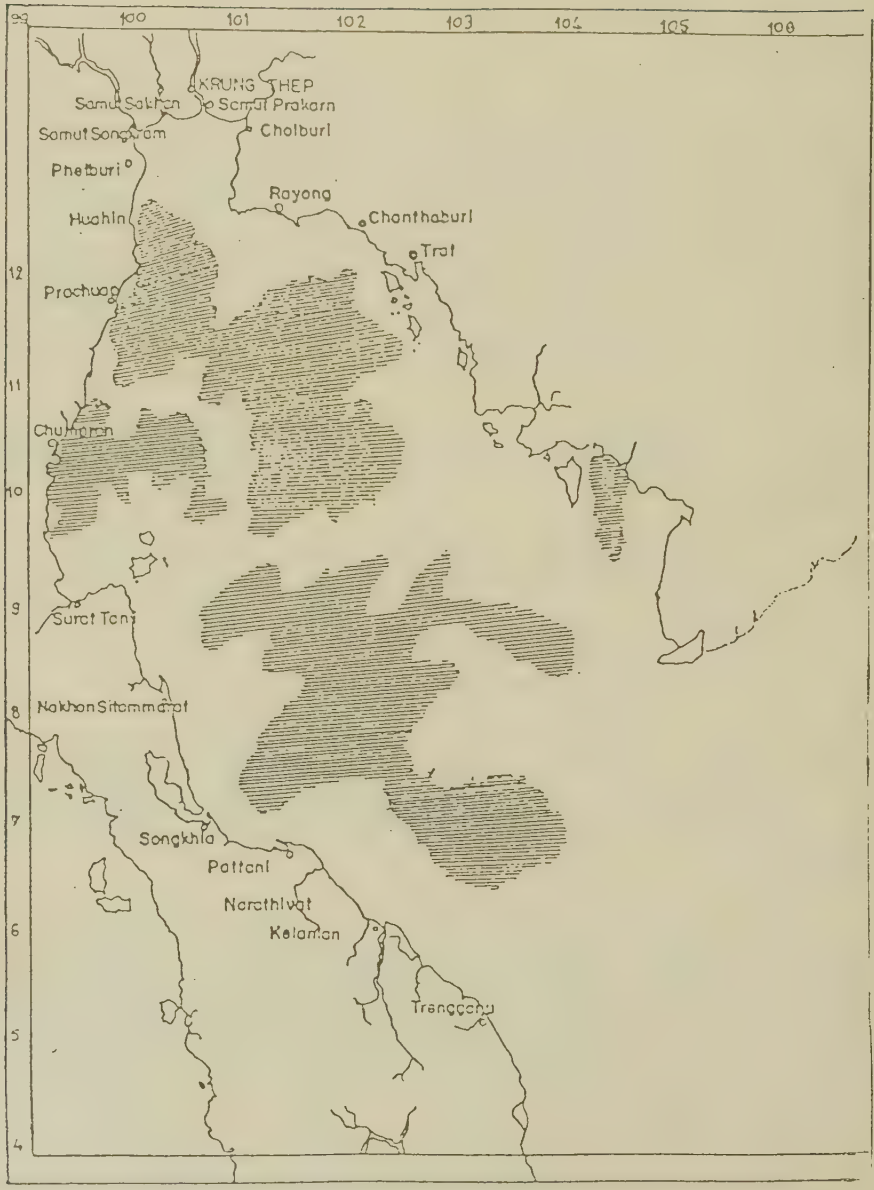

Figure 3 The fishing grounds of Indian mackerel (Rastrelliger kanagurta) in the Gulf of Thailand

Figure 4 The fishing grounds of Sardine (Sardinella spp.) in the Gulf of Thailand

equipment at Pattani. Development, installation, testing and recommendations for implementation were undertaken by the FAO/DANIDA project with some success. However, the benefits of this project have not accrued to the Fishermen's Cooperative in Pattani but to a company in the private sector which is currently using the equipment effectively.

It is now important to examine the possibilities for technological improvement through the whole marketing chain and examine their commercial potential.

7.3 Pre-Feasibility Study

The alternative market outlets for small pelagic species caught in the South of Thailand may be exploited either by increased production of canned fish or by investment in a transportation system to markets such as Bangkok.

The success of both options would depend initially on an improvement in quality to a level higher than that presently available. Efficient conversion of purse seiners from bulk storage to CSW storage would assist this improvement. The installation of unloading conveyors and sorting conveyors in accordance with the FAO/DANIDA project recommendations would also be of advantage.

The cannery option requires an investment in CSW storage on shore, whilst the option for fresh fish marketing in Bangkok depends on an investment in insulated trucks. An investment in CSW storage for the latter is regarded as inappropriate because of the length of the fishing trips and the urgent need to reduce delays in the port area.

This profile presents extremely difficult problems as there is no obvious potential for market expansion of either canned products or fresh sardine distributed over a wider area. In fact the interviews held with personnel in fishery institutions in Thailand suggested that there was consumer resistance to products made from small pelagic species.

The approach in this study has been to propose reasonable price increments for each of the options and to evaluate their consequent financial and economic viability. The risks, even at the outset, are regarded as high, but if assessments of the markets are to be recommended then the options for development must be proven.

7.4 Financial Analysis

The financial analyses indicate that both options, based on the assumptions given for prices and inputs, are financially viable. The

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financial internal rate of return (FIRR) for the fresh fish option is estimated at 18%, whilst that for the canning option is estimated at 26.9%. These rates of return are more sensitive to changes in revenues than either capital costs or operating costs and a drop of 10% in revenues gives a reduction of FIRR to 6.9% for the fresh fish option and 22.5% for the cannery option. This fall in FIRR to 6.9% for a project designed to deliver fish from southern Thailand to Bangkok emphasizes the high risk.

7.5 Economic Analysis

The economic analysis is based upon the financial data with the following adjustments:

(i) prices for capital goods have been adjusted by a factor of 80% to exclude the tax component;

(ii) no adjustment has been made for labour costs;

(iii) transfer payments have been eliminated.

The economic internal rates of return (EIRR) are 32.7% and 32.9% for the fresh fish and the cannery options respectively.

7.6 Conclusions

The purpose of a feasibility study is not only to determine whether the project is sufficiently promising from the financial and economic points of view, but also to identify aspects of the project that appear to be uncertain and merit further attention.

This project exhibits a high degree of risk and such investments cannot be recommended at this stage. There is also no case for a vessel study and priority should be given to market development projects. The cannery option shows some promise but there is a need to carry out marketing studies. The project option designed to investigate the delivery of fresh fish to Bangkok appears to be doubtful and perhaps more effort should be put into new product development.

7.7 Brief Description of Analysis Tables for Thailand

Financial Unit = Baht 1 000

Analysis Table	Description
7.1 and 7.2	That purser; operational analysis of a single vessel using CSW stowage, based at Songkhla or Pattani.
7.3	Landings, costs and revenues resulting from an investment schedule to convert 25 pursers to CSW stowage over 5 years.
7.4	Utilization of improved quality sardine landings resulting from investment in analysis 7.3 in canning for human consumption.
7.5	Financial and economic analyses of costs and benefits, with sensitivity analyses, for the canning option in analysis 7.4.
7.6	Costs for a 10 t insulated truck.
7.7	Operational analysis for inland distribution to Bankok of sardine landings resulting from the fleet conversion investment in 7.3. Calculates optimum number of trucks and utilization of both landings and transport.
7.8	Financial and economic analyses of costs and benefits, with sensitivity analyses, for the inland distribution option in analysis 7.7.

Length o/a	20.5	m	
Main engine power	220	hp	
Fuel consumption	0.18	kg/hp/h	
Steaming speed	8.8	kn	
Fuel capacity	4	t	
Fishroom capacity	47	m^3	
Stowage rate	0.7	t/m^3	
Capital cost; boat	2042	Baht'000	
CSW Stowage	267	Baht'000	
nets	817	Baht'000	
total	2859		
Depreciation period	15	yrs	
Annual depreciation	17.8	Baht'000	(CSW conversion only)
Operating pattern			
Power used fishing(% of full)	40%		
Distance to fishing grounds	160	nm	
Steaming time to grounds	18.1	h	
Maximum fishing time	36	h	
Maximum trip duration	72	h	
Days at sea, year 1	170		
Annual trend, days at sea	-1.00%		

	mackerel	sardine	other	tot/ave	
Proportion of catch	11%	46%	43%	100%	
Catch rate on grounds, year 1	0.04	0.16	0.15	0.35	t/h
Annual trend, catch rate	-2.0%	-2.0%	-2.0%		
Sale price, port; year 1	7.02	1.93	13.18	3.64	Baht/kg
Annual trend, fish prices	0.0%	0.0%	0.0%		

Fuel cost price; year 1	6.99	Baht/kg
Annual trend, fuel price	0.0%	

Year	1	2	3	4	5	6	7	8	9	10
Days at sea	170	168.3	166.6	164.9	163.2	161.5	159.8	158.1	156.4	154.7
Catch rate; mackerel	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03
sardine	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.13
other	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.12
total	0.35	0.34	0.34	0.33	0.32	0.32	0.31	0.30	0.29	0.29
Catch/trip, all species; tons	12.60	12.35	12.10	11.84	11.59	11.34	11.09	10.84	10.58	10.33
Average fishing time/trip; h	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
Catch/trip, tons; mackerel	1.38	1.36	1.33	1.30	1.27	1.25	1.22	1.19	1.16	1.13
sardine	5.82	5.70	5.58	5.47	5.35	5.23	5.12	5.00	4.89	4.77
other	5.40	5.29	5.18	5.08	4.97	4.86	4.75	4.64	4.54	4.43
Average trip duration; days	3.01	3.01	3.01	3.01	3.01	3.01	3.01	3.01	3.01	3.01
Average number of trips	56.67	56.10	55.53	54.97	54.40	53.83	53.27	52.70	52.13	51.57
Annual catch, tons; mackerel	78.4	76.1	73.8	71.5	69.2	67.0	64.9	62.7	60.6	58.5
sardine	329.6	319.8	310.1	300.5	291.1	281.8	272.6	263.6	254.7	245.9
other	306.0	296.9	287.9	279.0	270.3	261.6	253.1	244.8	236.5	228.4
total	714.0	692.7	671.7	651.0	630.6	610.5	590.6	571.1	551.8	532.8
Revenue, Baht'000; mackerel	550.3	533.9	517.8	501.8	486.1	470.5	455.2	440.2	425.3	410.7
sardine	636.1	617.1	598.4	580.0	561.8	543.9	526.2	50 .7	491.6	474.7
other	4033.2	3913.0	3794.5	3677.5	3562.2	3448.4	3336.3	3225.8	3116.9	3009.6
total	5219.7	5064.1	4910.7	4759.3	4610.0	4462.8	4317.7	4174.7	4033.8	3894.9
Operating costs, Baht '000										
Crew Share	2087.9	2025.7	1964.3	1903.7	1844.0	1785.1	1727.1	1669.9	1613.5	1558.0
Wages, food, other	222.2	222.2	222.2	222.2	222.2	222.2	222.2	222.2	222.2	222.2
Fuel	794.6	786.7	778.7	770.8	762.8	754.9	746.9	739.0	731.0	723.1
Lubricants	42.6	42.2	41.7	41.3	40.9	40.5	40.0	39.6	39.2	38.8
Ice	62.8	34.3	33.3	32.2	31.2	30.2	29.2	28.3	27.3	26.4
Commission	156.6	151.9	147.3	142.8	138.3	133.9	129.5	125.2	121.0	116.8
Other vessel operating costs	164.2	164.2	164.2	164.2	164.2	164.2	164.2	164.2	164.2	164.2
Repairs, maintenance	61.3	81.7	102.1	122.5	142.9	163.4	183.8	204.2	224.6	245.1
Nets and gear	816.8	0.0	0.0	816.8	0.0	0.0	816.8	0.0	0.0	816.8
Admin	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Insurance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total operating cost	4414.6	3514.4	3459.4	4222.2	3352.2	3299.9	4065.5	3198.2	3148.7	3916.9
Operating profit	805.1	1549.7	1451.3	537.1	1257.8	1162.9	252.3	976.5	885.1	-22.0
Net benefit/purser	-1237.0	1549.7	1451.3	537.1	1257.8	1162.9	252.3	976.5	885.1	-22.0

Thai Purser — Analysis Table 7.3

Year	1	2	3	4	5	6	7	8	9	10	
Project schedule											
Number of pursers converted		5	5	5	5	5	*******	*******	*******	********	
Revenue		26098	51419	75972	99769	122819	119035	115303	111623	107995	Baht'000
Operating cost		22073	39645	56942	78053	94814	89241	91996	90690	85322	Baht'000
Depreciation		89	178	267	356	445	445	445	445	445	Baht'000
Shore operations; days/year	250										
Ave landed/day, tons; mackerel		1.57	3.09	4.56	5.99	7.38	7.15	6.93	6.71	6.49	tonnes
sardine		6.59	12.99	19.19	25.20	31.02	30.06	29.12	28.19	27.28	tonnes
other		8.47	16.52	24.17	31.42	38.30	36.35	34.46	32.64	30.88	tonnes
Number of sorting conveyors reqd		1	1	2	2	2	2	2	2	2	
Investment cost; CSW holds	1335	1335	1335	1335	1335	0	0	0	0	-1335	Baht'000
conveyors	215	0	215	0	0	0	0	0	0	0	Baht'000
total	1550	1335	1550	1335	1335	0	0	0	0	-1335	

Analysis Table 7.4

Year	1	2	3	4	5	6	7	8	9	10
Shore operations; days/year	250									
Ave landed/day, tons; mackerel		1.57	3.09	4.56	5.99	7.38	7.15	6.93	6.71	6.49
sardine		6.59	12.99	19.19	25.20	31.02	30.06	29.12	28.19	27.28
other		8.47	16.52	24.17	31.42	38.30	36.35	34.46	32.64	30.88
Processing capacity reqd/day; tons		6.59	12.99	19.19	25.20	31.02	30.06	29.12	28.19	27.28
Local cannery capacity, t/day		30	30	30	30	30	30	30	30	30
CSW buffer store; tons		30	30	30	30	30	30	30	30	30
Ave canned/day		6.59	12.74	17.16	19.74	21.29	21.08	20.84	20.61	20.37
mackerel		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sardine		6.59	12.74	17.16	19.74	21.29	21.08	20.84	20.61	20.37
other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ave canned/year		1648	3186	4290	4934	5322	5271	5211	5151	5093
Incremental prices; mackerel	0.00	Baht/kg								
sardine	0.50	Baht/kg	(Best canning quality v cat food)							
other	0.00	Baht/kg								
Incremental revenue; mackerel		0	0	0	0	0	0	0	0	0
sardine		824	1593	2145	2467	2661	2635	2605	2576	2546
other		0	0	0	0	0	0	0	0	0
total		824	1593	2145	2467	2661	2635	2605	2576	2546
Operating cost, CSW buffer		88	170	229	263	284	281	278	275	272
Investment cost, CSW buffer	1000									

Year	1	2	3	4	5	6	7	8	9	10
1. Cash Inflow	Baht'000									
Incremental revenue		824	1593	2145	2467	2661	2635	2605	2576	2546
Total Inflow	0	824	1593	2145	2467	2661	2635	2605	2576	2546
2. Cash Outflow										
Operating Costs										
Sorting (nett increment)		0	0	0	0	0	0	0	0	0
CSW buffer store		88	170	229	263	284	281	278	275	272
Sub-total Operating Cost	0	88	170	229	263	284	281	278	275	272
Investment Costs										
CSW Holds	1335	1335	1335	1335	1335	0	0	0	0	-1335
Sorting conveyors	215	0	215	0	0	0	0	0	0	0
CSW buffer store	1000									
Sub-total Investment Cost	2550	1335	1550	1335	1335	0	0	0	0	-1335
Total Outflow	2550	1423	1720	1564	1598	284	281	278	275	-1064
3. Net Benefit Before Financing	-2550	-599	-127	581	869	2377	2354	2328	2301	3610
Financing (indicative example)										
Loan	4000	4000								
Borrower's Contribution	500	500								
Repayment on Principal	217	463	523	591	667	754	852	963	1088	1230
Interest Payment	520	1012	952	884	807	720	622	511	386	245
Net Financing	3763	3026	-1474	-1474	-1474	-1474	-1474	-1474	-1474	-1474
Net Cash Flow; annual	1213	2426	-1601	-893	-606	903	880	853	827	2136
cumulative	1213	3640	2038	1145	540	1443	2323	3176	4002	6138

Internal Rate of Return — Financial: 26.9% — Economic: 32.9%

Sensitivity Analysis		IRR	Switching Values at 10.0%		IRR	Switching Values at 10.0%
Variations of:-	by :-			by :-		
Investment Cost	10.0%	23.4%	69.4%	10.0%	29.0%	97.0%
Operating Cost	10.0%	26.5%	343.1%	10.0%	32.4%	412.5%
Revenue	-10.0%	22.5%	-36.6%	-10.0%	28.1%	-44.0%

Vehicle type	Long distance 10 ton (insulated)	
Payload	6.67	tons
Round trip distance	1600	km
Round trip duration	3	days
Capital cost	850.0	Baht '000
Depreciation period	8	years
Operating costs/year;Baht '000		
	active	standby
Insurance	0.00	20.00
Road tax	4.00	10.00
Fuel	223.33	
Lubricants	22.33	
Maintenance	43.00	20.00
Driver	26.40	
Assistant driver	25.00	
Driver overnight allowance	150.00	
Ice	29.75	
Total	523.81	50.00
Fuel price	6.7	Baht/litre
Fuel consumption	25.00	litres/100km
Ice price	267	Baht/ton

Year	1	2	3	4	5	6	7	8	9	10
Shore operations; days/year	250									
Ave landed/day,tons; mackerel		1.57	3.09	4.56	5.99	7.38	7.15	6.93	6.71	6.49
sardine		6.59	12.99	19.19	25.20	31.02	30.06	29.12	28.19	27.28
other		8.47	16.52	24.17	31.42	38.30	36.35	34.46	32.64	30.88
Transport reqd/day; tons		6.59	12.99	19.19	25.20	31.02	30.06	29.12	28.19	27.28
Long distance trucks/day; optimum		1	2	3	4	5	5	5	5	5
selected		1	2	3	4	5	5	5	5	5
Long distance trucks required; active		3	6	9	12	15	15	15	15	15
Long distance trucks required; standby		1	1	1	2	2	2	2	2	2
Number of long distance trucks purchased		4	3	3	4	3	0	0	0	4
Local delivery vehicles required: active		0	0	0	0	0	0	0	0	0
Local delivery vehicles required: standby		0	0	0	0	0	0	0	0	0
Local delivery vehicles purchased		0	0	0	0	0	0	0	0	0
CSW buffer store; tons		0	0	0	0	0	0	0	0	0
Ave transported/day to Bankok		4.19	8.33	12.41	16.44	20.42	20.14	19.84	19.54	19.23
mackerel		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sardine		4.19	8.33	12.41	16.44	20.42	20.14	19.84	19.54	19.23
other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ave transported/year to inland markets; t		1048	2083	3103	4110	5104	5035	4960	4886	4808
Incremental prices; mackerel	0.00	Baht/kg	(Bangkok market v fish meal)							
sardine	2.50	Baht/kg								
other	0.00	Baht/kg								
Incremental revenue; mackerel		0	0	0	0	0	0	0	0	0
sardine		2621	5206	7758	10276	12761	12587	12399	12214	12021
other		0	0	0	0	0	0	0	0	0
total		2621	5206	7758	10276	12761	12587	12399	12214	12021
Operating cost, trucks		1621	3193	4764	6386	7957	7957	7957	7957	7957
CSW buffer		0	0	0	0	0	0	0	0	0
Investment cost, trucks		3400	2550	2550	3400	2550	0	0	0	-1700
CSW buffer	0									
Depreciation, trucks		425	744	1063	1381	1700	1700	1700	1700	1700

Summary : Thai Fresh Sardines to Bankok

Analysis Table 7.8

Year	1	2	3	4	5	6	7	8	9	10
1. Cash Inflow										
Incremental revenue		2621	5206	7758	10276	12761	12587	12399	12214	12021
Total Inflow	0	2621	5206	7758	10276	12761	12587	12399	12214	12021
2 Cash Outflow										
Operating Costs										
Sorting (nett increment)		0	0	0	0	0	0	0	0	0
Trucks		1621	3193	4764	6386	7957	7957	7957	7957	7957
CSW buffer store		0	0	0	0	0	0	0	0	0
Sub-total Operating cost	0	1621	3193	4764	6386	7957	7957	7957	7957	7957
Investment Costs										
CSW Holds	1335	1335	1335	1335	1335	0	0	0	0	-1335
Sorting conveyors	215	0	215	0	0	0	0	0	0	0
Trucks		3400	2550	2550	3400	2550	0	0	0	-1700
CSW buffer store	0									
Sub-total Investment Cost	1335	4735	3885	3885	4735	2550	0	0	0	-3035
Total Outflow	1335	6357	7078	8650	11121	10507	7957	7957	7957	4922
3. Net Benefit Before Financing	-1335	-3736	-1872	-891	-845	2254	4630	4442	4257	7099
Financing (indicative example)										
Loan	10000	10000	10000							
Borrower's Contribution	2500	2500	2500							
Repayment on Principal	543	1156	1850	2090	2362	2669	3016	3408	3851	4351
Interest Payment	1300	2529	3679	3439	3167	2860	2513	2121	1678	1177
Net Financing	10657	8814	6971	-5529	-5529	-5529	-5529	-5529	-5529	-5529
Net Cash Flow; annual	9322	5078	5100	-6420	-6374	-3275	-899	-1086	-1271	570
cumulative	9322	14400	19500	13079	6706	3431	2532	1446	174	1745

Internal Rate of Return — Financial: 18.0% — Economic: 32.7%

Sensitivity Analysis

Variations of:-	by :-	IRR	Switching Values at 10.0%	by :-	IRR	Switching Values at 10.0%
Investment Cost	10.0%	14.3%	24.6%	10.0%	27.8%	71.2%
Operating Cost	10.0%	11.1%	11.5%	10.0%	25.5%	30.4%
Revenue	-10.0%	6.9%	-7.3%	-10.0%	20.0%	-17.5%

8. THE MOROCCO SARDINE FISHERY

8.1 Background

Morocco is the main participant in the North African sardine (Sardina pilchardus) fishery. The canning and meal industry began in 1930 and increased rapidly after 1945 until the mid-fifties. During the sixties some problems and contraction were experienced.

The major part of the landings, caught by purse-seiners, are exported either in the form of canned sardines or fish meal and oil. Earlier work for FAO by FIDECO showed a considerable potential for domestic marketing of sardines, but there has been no further development suggesting that with a population increase of about 3% per year, the domestic demand may be higher.

The FAO project introduced CSW technology into this fishery with some success from the techological point of view.

8.2 Technological Development

The fish is caught by purse seiners varying considerably in size and power but there is little use of ice. If fish of sufficiently high quality is to be made available, then conversion to include CSW storage is important.

Fish is currently transported by truck to the processing plants in boxes without ice. If fish is to be transported from the ports to the provincial towns and rural areas, then there should be CSW buffer storage facilities in the port. The trucks providing the transport service should be insulated, keeping the temperature low by the use of ice. Storage facilities are needed in the provincial cities and local transport for deliveries to urban market places, retailers and rural souks.

8.3 The Pre-Feasibility Study

The study includes the conversion of purse seiners to CSW storage, investment in CSW tanks on shore, the purchase of 10-t trucks for long distance deliveries, e.g., Agadir to Meknes, and, 3.5-t trucks for local deliveries.

Normal operation of traditional Agadir pursers means overnight trips to nearby fishing grounds in the region marked A on the map (Figure 5). The operational analysis for this investment study assumes that a converted purser would venture much further to relatively unexploited grounds to the south (B on map), thereby gaining opportunities of higher catch rates. As a result of improved quality through CSW storage, a much greater proportion of the catch would be suitable for marketing as fresh fish. Only a conservative

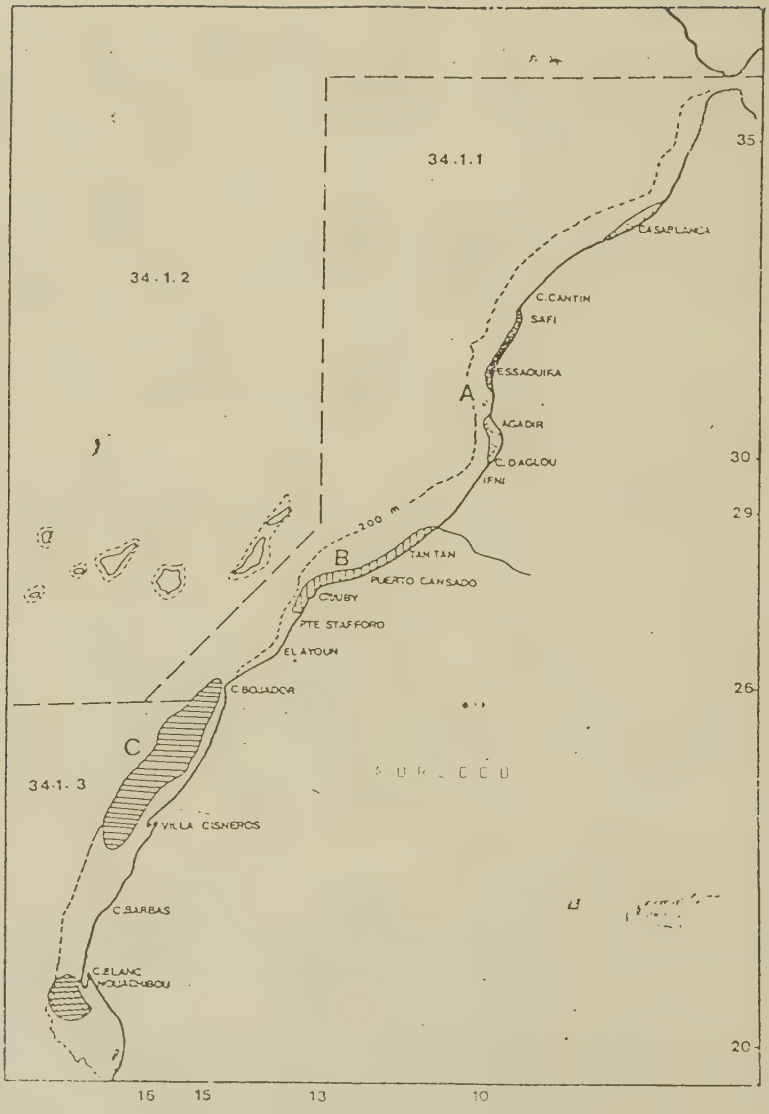

Figure 5 Main fishing areas (Zones A, B and C) of the sardine fishery

estimate has been used here, with no price advantage to the vessel. The incremental priced used in this analysis are insufficient to cover the operating costs of inland distribution to total revenues to enable an integrated operation of pursers, buffer store and road vehicles to be profitable. it is assumed throughout that the CSW buffer store at Agadir can hold one day's average long-distance transport capacity.

The integrated investment comprises a total of 25 pursers modified at 5 per year, plus the optimal number of road vehicles to distribute the designated fresh portion of landings (a peak of 45 long-distance and 34 local delivery trucks). The total capital invested is about 45 million dirhams over 10 years, of which most is in vehicles: only 4.25 million dirhams is required for vessel modifications.

8.4 Financial Analysis

The financial analysis, based on the assumptions described above for prices and costs, shows that an integrated project can be viable. The financial internal rate of return (FIRR), estimated at 24.2% is highly sensitive to changes in revenues and operating costs, but not to changes in the investment cost.

In the indicative example of financing, interest rates of 12% have been used on loans in the first year borrowed over 10 years. Loans in other years have been repaid over 4 years. None of these loans has been allowed a period of grace.

8.5 Economic Analysis

The economic analysis is based upon the financial data with the following adjustments:

(i) prices for capital goods have been adjusted by a factor of 80% to exclude the tax component;

(ii) no adjustment has been made for labour costs;

(iii) transfer payments have been eliminated.

The economic rate of return is estimated at 59% showing the market effect of high levels of taxation within the fishery.

8.6 Conclusions

The purse-seiner fishery in Morocco is characterized by a complicated system of quotas, fixed prices and quality requirements favouring steady supplies to the canning industry. Any departure from this pattern will require adaptations in many areas and it is probable that prevailing conditions will constrain the activities of CSW

purse seiners more than the analysis suggests. However, the rates of return and the sensitivity analyses give cause for optimism for such a project, but it is important that an integrated system with the marketing sector should be established.

The project cannot be regarded as having passed the identification "test" as there is a requirement for additional projects in two areas.

The pre-requisites for an investment project are a design study for converting purse seiners to CSW storage, and an up-to-date survey for northern Morocco to determine the market potential of fresh small pelagic fish.

8.7 Brief Description of Analysis Tables for Morocco

Financial Unit = M.Dh 1 000

Analysis Table	Description
8.1	Agadir purser; differences in costs, prices and operations between a traditional vessel and one modified for CSW stowage.
8.2	Operational analysis for traditional purser.
8.3	Operational analysis for purser modified for CSW stowage.
8.4	Incremental landings, costs and revenues resulting from an investment schedule to convert 25 pursers for CSW stowage over 5 years.
8.5	Costs for a 10 t insulated truck for long-distance operation and for a 3.5 t local delivery truck.
8.6	Operational analysis for inland distribution from Agadir by road, of incremental landings resulting from the fleet modification investment schedule in analysis 8.4. Calculates optimum number of trucks and utilization of both landings and transport.
8.7	Financial and economic analyses of costs and benefits, with sensitivity analyses.

Length o/a	22	m								
Main engine power	300	hp								
Power used fishing(% of full)	40%									
Fuel consumption	0.18	kg/hp/h								
Steaming speed	9.1	kn								
Fuel capacity	5	t								
TJB	55.0	tx								
Conversion Cost, CSW Stowage	170	M.Dh'000								
Capital cost; boat	1300	M.Dh'000								
nets	325	M.Dh'000								
total	1625									
Depreciation period	10	yrs								
Annual depreciation	17.0	M.Dh'000 (CSW conversion only)								
Operating pattern	----------	Traditional Operation ----------				----------	Operation with CSW ----------			
Stowage rate	0.4	t/m^3				0.7	t/m^3			
Distance to fishing grounds	7	nm				80	nm			
Steaming time to grounds	0.77	h				8.75	h			
Maximum fishing time	9.00	h				17.00	h			
Maximum trip duration	10.53	h				34.50	h			
Days at sea, year 1	180					225				
Annual trend, days at sea	-1.00%					-1.00%				
	mackerel	sardine	other	tot/ave		mackerel	sardine	other	tot/ave	
Proportion of catch	35.1%	60.3%	4.6%	100%		35.1%	60.3%	4.6%	100%	
Catch rate on grounds, year 1	0.32	0.54	0.04	0.90		0.56	0.96	0.07	1.59	t/h
Annual trend, catch rate	0.0%	0.0%	0.0%			-3.0%	-3.0%	-3.0%		
Destination; fresh	8.0%	8.0%	8.0%			40.0%	40.0%	40.0%		
freezing	3.0%	3.0%	3.0%			3.0%	3.0%	3.0%		
canning	19.0%	19.0%	19.0%			19.0%	19.0%	19.0%		
meal/oil	70.0%	70.0%	70.0%			38.0%	38.0%	38.0%		
Price to boat, year 1 ; fresh	0.79	1.07	0.87			0.79	1.07	0.87		M.Dh/kg
freezing	0.79	1.07	0.87			0.79	1.07	0.87		M.Dh/kg
canning	0.85	1.07	0.75			0.85	1.07	0.75		M.Dh/kg
meal/oil	0.32	0.32	0.32			0.32	0.32	0.32		M.Dh/kg
Average price to boat; year 1	0.47	0.55	0.46	0.52		0.62	0.79	0.64	0.72	M.Dh/kg
Annual trend, fish prices	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%		
Price of ice	200	M.Dh/tonne								
Price of gasoil; year 1	1.90	M.Dh/kg								
Annual trend, gasoil price	0.0%									

Agadir Purser

Analysis Table 8.2

Year	1	2	3	4	5	6	7	8	9	10
Traditional operation										
Days at sea	180.0	178.2	176.4	174.6	172.8	171.0	169.2	167.4	165.6	163.8
Catch rate; mackerel	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
sardine	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
other	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
total	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Catch/trip, all species; tons	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10
Average fishing time/trip; h	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Catch/trip, tons; mackerel	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84
sardine	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89
other	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Average trip duration; days	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Average number of trips	180.0	178.2	176.4	174.6	172.8	171.0	169.2	167.4	165.6	163.8
Annual catch, tons; mackerel	512	507	502	496	491	486	481	476	471	466
sardine	880	871	862	853	845	836	827	818	809	801
other	66	66	65	64	64	63	62	62	61	60
total	1458	1443	1429	1414	1400	1385	1371	1356	1341	1327
Revenue, M.Dh'000; mackerel	241.8	239.4	237.0	234.5	232.1	229.7	227.3	224.9	222.4	220.0
sardine	479.4	474.7	469.9	465.1	460.3	455.5	450.7	445.9	441.1	436.3
other	30.7	30.4	30.1	29.8	29.5	29.2	28.9	28.6	28.3	27.9
total	751.9	744.4	736.9	729.4	721.9	714.4	706.8	699.3	691.8	684.3
Operating costs, M.Dh '000										
Taxes	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4
CNSS	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3
Total, Taxes and Fees	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7
Fuel	94.8	93.8	92.9	91.9	91.0	90.0	89.1	88.1	87.2	86.2
Lubricants	4.7	4.7	4.6	4.6	4.5	4.5	4.5	4.4	4.4	4.3
Food	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Ice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total, Common Costs	112.7	111.7	110.7	109.7	108.7	107.7	106.7	105.7	104.7	103.7
Crew's Share	323.8	319.9	315.9	312.0	308.1	304.2	300.3	296.4	292.5	288.5
Repairs, maintenance	39.0	52.0	65.0	78.0	91.0	104.0	117.0	130.0	143.0	156.0
Nets and gear	325.0	0.0	0.0	325.0	0.0	0.0	325.0	0.0	0.0	325.0
Insurance	26.0	23.4	20.8	18.2	15.6	13.0	10.4	7.8	5.2	2.6
Total, Owner's Costs	390.0	75.4	85.8	421.2	106.6	117.0	452.4	137.8	148.2	483.6
Total Costs	926.1	606.6	612.1	942.6	623.1	628.6	959.0	639.5	645.0	975.5
Prime de Filet	75.2	74.4	73.7	72.9	72.2	71.4	70.7	69.9	69.2	68.4
Payment Surplus	-99.0	212.3	198.5	-140.2	171.0	157.2	-181.5	129.7	115.9	-222.8
Total operating cost	109.6	108.6	107.6	106.6	105.6	104.6	103.6	102.6	101.7	100.7

Year	1	2	3	4	5	6	7	8	9	10
Operation with CSW										
Days at sea	180.0	178.2	176.4	174.6	172.8	171.0	169.2	167.4	165.6	163.8
Catch rate; mackerel	0.56	0.54	0.52	0.51	0.49	0.47	0.46	0.44	0.42	0.41
sardine	0.96	0.93	0.90	0.87	0.84	0.81	0.79	0.76	0.73	0.70
other	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.05
total	1.59	1.54	1.49	1.45	1.40	1.35	1.30	1.25	1.21	1.16
Catch/trip, all species; tons	27.00	26.19	25.38	24.57	23.76	22.95	22.14	21.33	20.52	19.71
Average fishing time/trip; h	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00
Catch/trip, tons; mackerel	9.48	9.19	8.91	8.63	8.34	8.06	7.77	7.49	7.20	6.92
sardine	16.29	15.80	15.31	14.82	14.34	13.85	13.36	12.87	12.38	11.89
other	1.23	1.19	1.16	1.12	1.08	1.05	1.01	0.97	0.94	0.90
Average trip duration; days	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44
Average number of trips	90.0	89.1	88.2	87.3	86.4	85.5	84.6	83.7	82.8	81.9
Annual catch, tons; mackerel	853	819	786	753	721	689	658	627	596	567
sardine	1466	1408	1351	1294	1239	1184	1130	1077	1025	974
other	111	106	102	98	94	89	85	81	77	74
total	2430	2334	2239	2145	2053	1962	1873	1785	1699	1614
Revenue, M.Dh'000; mackerel	531.3	510.2	489.4	469.0	448.8	429.0	409.5	390.3	371.5	352.9
sardine	1151.0	1105.3	1060.3	1016.0	972.3	929.4	887.2	845.6	804.8	764.6
other	70.7	67.9	65.1	62.4	59.7	57.1	54.5	51.9	49.4	47.0
total	1752.9	1693.3	1614.8	1547.3	1480.9	1415.5	1351.2	1287.9	1225.6	1164.5
Operating costs, M.Dh '000										
Taxes	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4
CNSS	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3
Total, Taxes and Fees	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7	99.7
Fuel	224.4	222.1	219.9	217.7	215.4	213.2	210.9	208.7	206.4	204.2
Lubricants	22.4	22.2	22.0	21.8	21.5	21.3	21.1	20.9	20.6	20.4
Food	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Ice	160.4	154.0	147.7	141.6	135.5	129.5	123.6	117.8	112.1	106.5
Miscellaneous	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total, Common Costs	420.4	411.5	402.8	394.1	385.6	377.1	368.8	360.5	352.4	344.3
Crew's Share	739.7	703.3	667.4	632.1	597.4	563.2	529.6	496.6	464.2	432.3
Repairs, maintenance	39.0	52.0	65.0	78.0	91.0	104.0	117.0	130.0	143.0	156.0
Nets and gear	325.0	0.0	0.0	325.0	0.0	0.0	325.0	0.0	0.0	325.0
Insurance	26.0	23.4	20.8	18.2	15.6	13.0	10.4	7.8	5.2	2.6
Total, Owner's Costs	390.0	75.4	85.8	421.2	106.6	117.0	452.4	137.8	148.2	483.6
Total Costs	1649.8	1289.9	1255.7	1547.1	1189.2	1157.0	1450.5	1094.6	1064.4	1359.9
Prime de Filet	175.3	168.3	161.5	154.7	148.1	141.5	135.1	128.8	122.6	116.4
Payment Surplus	278.5	561.8	520.6	154.9	439.7	400.0	35.8	322.1	283.8	-79.0
Total operating cost	417.3	408.5	399.7	391.1	382.6	374.1	365.8	357.5	349.3	341.3

Agadir Purser

Analysis Table 8.4

Year	1	2	3	4	5	6	7	8	9	10	
Shore operations; days/year	300	(every year)									
Incremental Values for one vessel from using CSW											
Incr. Revenue	1001	939	878	818	759	701	644	589	534	480	M.Dh'000
Incr. Operating cost	308	300	292	284	277	269	262	255	248	241	M.Dh'000
Incr. fresh tonnes/day : mackere	1.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.6	tonnes/day
sardine	1.7	1.6	1.6	1.5	1.4	1.4	1.3	1.2	1.2	1.1	tonnes/day
other	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	tonnes/day
Schedule for Investment Project											
Number of pursers converted		5	5	5	5	5	*******	*******	*******	*******	
Incremental Revenue		5005	9699	14089	18178	21973	20474	19001	17555	16134	M.Dh'000
Incremental Operating cost		1539	3038	4498	5921	7305	7114	6925	6739	6555	M.Dh'000
Incr. fresh tonnes/day : mackerel		5.0	9.8	14.4	18.7	22.9	21.8	20.8	19.7	18.7	tonnes/day
sardine		8.6	16.8	24.7	32.2	39.3	37.5	35.7	33.9	32.2	tonnes/day
other		0.6	1.3	1.9	2.4	3.0	2.8	2.7	2.6	2.4	tonnes/day
Investment cost for CSW	850	850	850	850	850	0	0	0	0	-850	M.Dh'000
Depreciation		85	170	255	340	425	425	425	425	425	M.Dh'000

Vehicle type	Long distance 10 ton (insulated)		Local 3.5 ton (not insulated)	
Payload	6.67	tons	2.33	
Round trip distance	1500	km	200	
Round trip duration	4	days	1	
Capital cost	400.0	M.Dh '000	90	
Depreciation period	4	years	4	
Operating costs/year; M.Dh '000	active	standby	active	standby
Insurance	20.00	20.00	3.50	3.50
Road tax	10.00	10.00	1.40	1.40
Fuel	97.03		22.77	
Lubricants	9.70		2.28	
Maintenance	20.00	20.00	6.00	6.00
Driver	25.00		18.00	
Assistant driver	15.00			
Driver overnight allowance	15.30			
Ice	23.91		31.87	
Total	235.94	50.00	85.82	10.90
Fuel price	3.45	M.Dh/litre		
Fuel consumption	25.00	litres/100km	11.00	
Ice price	200	M.Dh/ton		

Year	1	2	3	4	5	6	7	8	9	10
Shore operations; days/year	300	(every year)								
Ave landed/day, tons; mackerel		5.00	9.79	14.36	18.72	22.87	21.81	20.76	19.74	18.73
sardine		8.60	16.83	24.68	32.17	39.30	37.48	35.69	33.92	32.19
other		0.65	1.27	1.86	2.43	2.97	2.83	2.70	2.56	2.43
Transport reqd/day; tons		14.26	26.62	39.04	50.89	62.17	59.29	56.45	53.66	50.92
Long distance trucks/day; optimum		3	4	6	8	10	9	9	9	8
selected		3	4	6	8	10	9	9	9	8
Long distance trucks required; active		12	16	24	32	40	36	36	36	32
Long distance trucks required; standby		2	2	3	4	5	4	4	4	4
Number of long distance trucks purchased		14	4	9	9	23	0	9	9	19
Local delivery vehicles required: active		9	12	18	24	30	27	27	27	24
Local delivery vehicles required: standby		1	2	2	3	4	3	3	3	3
Local delivery vehicles purchased		10	4	6	7	17	0	6	7	14
CSW buffer store; tons		20	27	40	53	67	60	60	60	53
Ave transported/day to inland markets		12.18	18.72	27.85	36.83	45.07	41.96	41.23	40.47	36.84
mackerel		4.27	6.88	10.24	13.55	16.80	15.43	15.16	14.89	13.55
sardine		7.35	11.83	17.60	23.28	28.87	26.52	26.06	25.58	23.29
other		0.55	0.89	1.33	1.76	2.18	2.00	1.97	1.93	1.76
Ave transported/year to inland markets; t		3653	5883	8753	11577	14355	13188	12959	12720	11579
Incremental prices; mackerel	0.50	M.Dh/kg	(inland market v fish meal)							
sardine	0.50	M.Dh/kg								M.Dh '000
other	1.00	M.Dh/kg								
Incremental revenue; mackerel		641	1033	1536	2032	2520	2315	2275	2233	2032
sardine		1102	1775	2641	3492	4331	3979	3910	3838	3493
other		83	134	199	264	327	301	295	290	264
total		1826	2941	4376	5789	7177	6594	6480	6360	5789
Operating cost, all vehicles		3715	4905	7357	9810	12262	11011	11011	11011	9810
CSW buffer		128	203	302	400	496	456	448	439	400
Investment cost, all vehicles		6500	1960	4140	4230	10730	0	4140	4230	-935
CSW buffer	1000									
Depreciation, all vehicles		1503	1970	2905	3840	4775	4308	4308	4308	3840

Summary : Inland Distribution from Agadir

Analysis Table 8.7

Year	1	2	3	4	5	6	7	8	9	10
1. Cash Inflow										
Incremental Revenue; fleet		5005	9699	14089	18178	21973	20474	19001	17555	16134
ashore		1826	2941	4376	5788	7177	6594	6480	6360	5789
Total Inflow		6831	12641	18465	23967	29151	27068	25481	23915	21924
2. Cash Outflow										
Incremental Operating cost										
Fleet		1539	3038	4498	5921	7305	7114	6925	6739	6555
Trucks		3715	4905	7357	9810	12262	11011	11011	11011	9810
CSW buffer store		128	203	302	400	496	456	448	439	400
Sub-total Operating cost		5381	8146	12158	16131	20064	18581	18384	18189	16765
Investment Cost										
Fleet	850	850	850	850	850	0	0	0	0	-850
Trucks		6500	1960	4140	4230	10730	0	4140	4230	-935
CSW buffer store	1000									
Sub-total Investment Cost	1850	7350	2810	4990	5080	10730	0	4140	4230	-1785
Total Outflow	1850	12731	10956	17148	21211	30794	18581	22524	22419	14980
3. Net Benefit Before Financing	-1850	-5900	1685	1317	2756	-1643	8487	2957	1495	6944
Financing (indicative example)										
Loan	15000	12500	12500							
Borrower's Contribution	5000	3000	3000							
Repayment on Principal	855	2925	5244	5873	6578	7367	4783	1890	2116	2370
Interest Payment	1800	3197	4346	3717	3012	2223	1339	765	538	284
Net Financing	17345	9378	5910	-9590	-9590	-9590	-6122	-2655	-2655	-2655
Net Cash Flow; annual	15495	3478	7595	-8273	-6834	-11233	2365	302	-1159	4289
cumulative	15495	18973	26568	18295	11461	228	2593	2895	1736	6025

Internal Rate of Return — Financial: 24.2% — Economic: 59.0%

Sensitivity Analysis

Variations of:-	by :-	IRR	Switching Values at 10.0%	by :-	IRR	Switching Values at 10.0%
Investment Cost	10.0%	17.0%	21.3%	10.0%	51.1%	88.4%
Operating Cost	10.0%	4.8%	7.5%	10.0%	44.4%	28.2%
Revenue	-10.0%	-5.9%	-5.3%	-10.0%	34.0%	-17.6%

9. CONCLUSIONS AND RECOMMENDATIONS

The important point to emphasize before considering the overall conclusions and recommendations is that these studies represent the first stage in the project cycle, i.e., project identification. The important part of project identification is that the project must meet a *prima facie* test of feasibility both financial and economic.

The projects investigated in the study have many similarities, not least that they are all related to small pelagic species and have all received the attention, effort and resources of the FAO/DANIDA programme. However, the projects are all at different stages, and in much of the detail, there are many differences.

One of the roles of project identification is to screen or modify project ideas. One of the factors that affects projects is excessive risks and solutions must be sought to reduce this aspect of investment. In the cases for Indonesia, India and Morocco, there is a need for vessel studies to produce or modify purse seiners for CSW held storage. Such studies would reduce risk and complement and assist investment programmes within these fisheries. Some attention to marketing is also required and is included in the appropriate country recommendations.

The study for Thailand is somewhat different. Although the current vessels do not have CSW storage, they approximate to it more closely than the purse seiners of the other countries. However, the location of their fish resources are more distant and voyages are of considerable length giving little gain with CSW storage.

There is additional risk through the doubtful market acceptance and more work is required in this area before an investment project for Thailand could be recommended.

The final conclusion of overall significance is that this kind of quantitative approach is now more readily available to a growing number of countries through the access of micro-computers and it can also be seen that a methodology and techniques are available. Data bases need to be improved to match the demands of these analyses but they are undoubtedly of great value for the detailed investigation of projects throughout the project cycle. The approach can obviously be extended well beyond the examples in this report and are appropriate, not only for other countries but also, for different fisheries.

APPENDIX 1

Further Information on the Operational Analyses

1. STRUCTURE

As shown in the flow chart (Figure 1), the operational analyses are built up from individual component microcomputer spreadsheet modules, each representing a discrete part of the real-life system. Links are provided between modules so that data and results can be automatically sent to where they are needed for further calculation. For example, a section dealing with investment in the fishing fleet typically passes results to two destinations: fish landing forecasts are moved to the next stage of the operational analysis, i.e., shore-based activities, whilst revenues and costs go to the financial/economic summary. This structure enables the user to concentrate on a particular area, trying out different ideas locally, without being forced to examine global consequences of every single change. Only the results of the final change need be used elsewhere in the analysis.

2. CONTENT

The mechanisms used within modules dwell only on such detail as is strictly relevant to the investment profile in question. For example, seasonal variation of supply can sometimes be treated as a simple constraint on days at sea, but on shore might require a monthly analysis for each year of the forecast. The same considerations apply to short-term random variation of supply, whose impact on shore processing and inland transport must be examined in detail. In this study, a similar approach to short-term aspects of fishing operations would be superfluous. There follows a brief description of the main models used.

3. VESSELS

The main effect of introducing CSW stowage on board a fishing vessel, apart from fish quality improvement, is to modify the constraints under which the boat must operate. The basic computer model used here defines the constraints governing vessel operations, and performs straightforward calculations to determine the results. Although not complex, the vessel modules are exhaustive, as can be seen from the appropriate analysis tables in Chapter 5 to 8.

Vessel performance is restricted in the analyses by the following main constraints:

Overall Structure of Operational Analyses

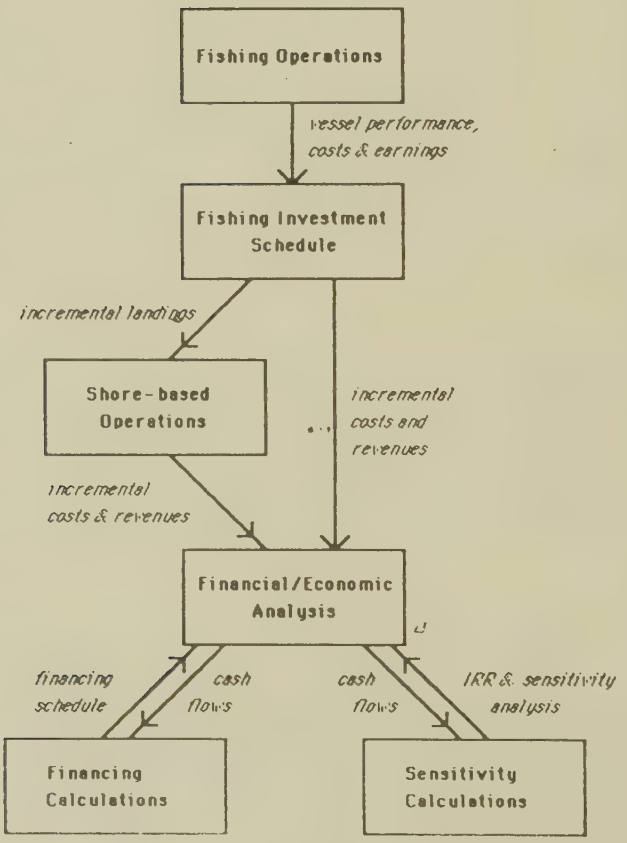

Figure 1 Overall structure of operational analyses

- hold capacity
- fuel capacity
- time available for fishing per trip
- days at sea per year

Other important variables include:

- horsepower
- age of vessel
- distance to fishing grounds
- catch rate
- operating and investment costs
- prices and revenues

All logical and temporal interactions between variables and constraints are included, e.g., age affects both days at sea and operating costs. The outcome in each case is a 10 year forecast of individual vessel operations, costs and earnings. If the investment comprises a CSW hold modification, the whole analysis is performed with and without the modification, so that incremental landings, revenues and operating costs can be estimated.

The final section is a schedule of the proposed investment, which calculates incremental landings, revenues and costs over a 10 year period for a group of vessels. These results are passed as input to appropriate destinations.

4. SHORE-BASED OPERATIONS

Central to the analyses of shore-based operations is the extent to which both the improved quality landings and the capacity to deal with them (processing and transport) can be utilized. In many small pelagic fisheries, the nature of their short-term variation pattern means that daily landings are below the seasonal average more often than above. On the rarer occasions when landings are above the seasonal average, the effects can be lessened by using buffer storage, such as CSW tanks. However, small pelagic landings tend to be so prolific when above the seasonal norm, that they swamp both regular processing/transport capacity and buffer storage. Even with good knowledge of the next days's landings, it is impossible to make full utilization of capacity, as the use of CSW is limited to 3 days from catching to final destination. The only way to obtain near 100% capacity utilization is to have a relatively large average raw material supply, which also guarantees great wastage of fish. Conversely, the only route toward 100% utilization of landings is to tolerate heavily under-utilized processing capacity, or vehicles often idle. It is important to obtain the best compromise between these extremes, especially as fish quality has already been enhanced by investment earlier in the chain. Only in this way can the optimal plan for shore-based investment be found.

In this study, it was essential to be able to predict the proportion of landings utilized over a wide range of average supply relative to shore-based capacity. Relative variation arises either through seasonally changing landings against fixed shore capacity, or through studying the effect of changing capacity (e.g., number of trucks) when average landings are steady. The relevant calculations are performed using "utilization functions" derived mathematically from the pattern of random variation expected for each case. These manipulations are too complex to be described in this report, especially when evaluating the benefits of buffer storage. Suffice it to mention that all the shore-based analyses use appropriate utilization functions. Figure 2 shows a typical example. In all cases time spent in buffer storage is limited to one day.

The flow chart in Figure 3 shows the general method for analysing shore-based transport operations. Note the iterative procedure to calculate the optimal number of trucks. Figure 4 shows the method used for the Bali Strait, a fishery which already has some canning and freezing capacity, plus a special requirement for reconciling conflicting data obtained during the consultants' mission.

5. FINANCIAL AND ECONOMIC ANALYSES

The analysis tables for each country show all calculations which finally lead, through the relevant operational assessments, to financial investment appraisal. Results of economic analyses are shown only as brief summaries (economic rate of return and sensitivity analysis) together with the financial summaries. Internal rate of return is calculated by the standard discounted cash flow method. None of the examples of financing an investment are more than indicative, although the interest rates used reflect those prevailing in the countries concerned. Switching values are calculated using a iterative search procedure, to avoid laborious manual trial and error.

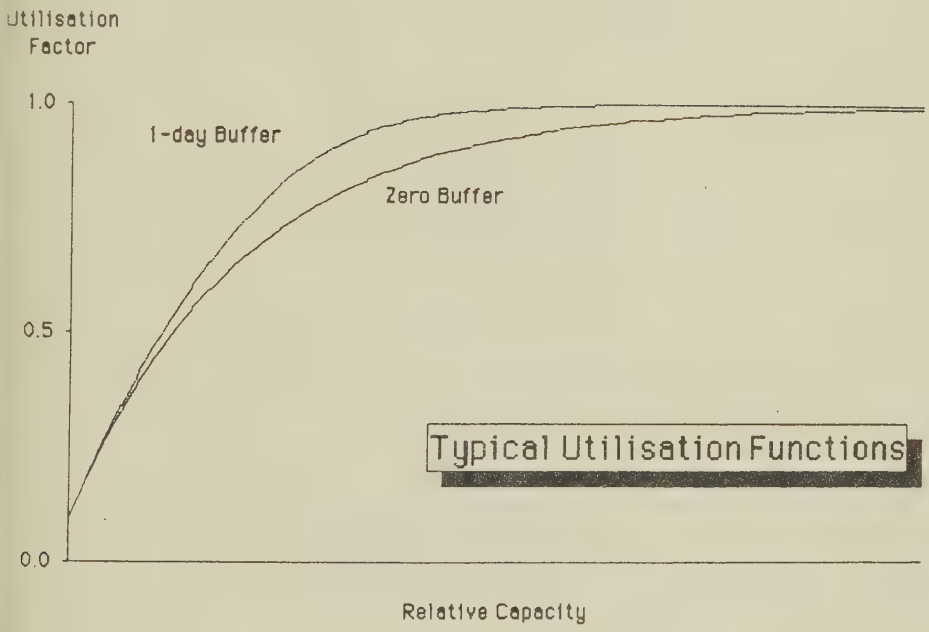

Figure 2 Typical utilization functions

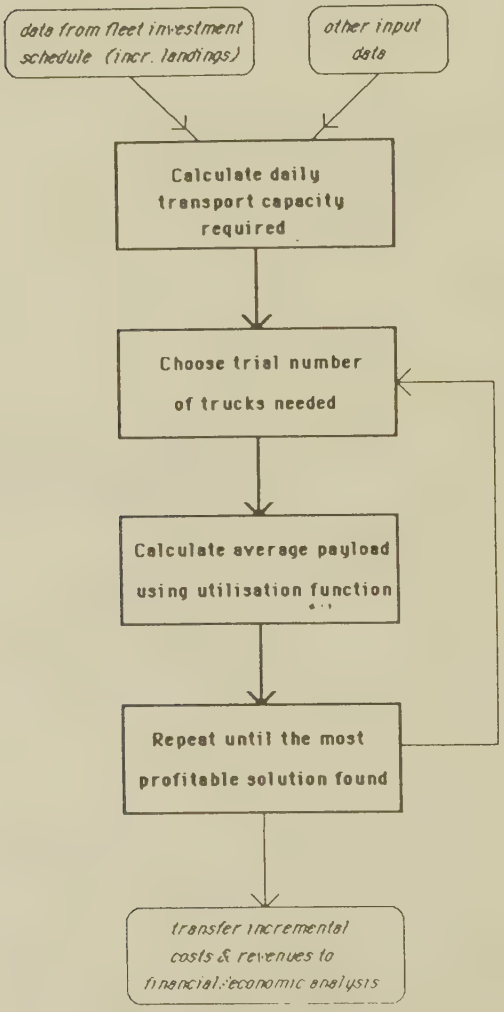
Structure of Shore-based Analyses
data from fleet investment schedule (incr. landings)
other input data
Calculate daily transport capacity required
Choose trial number of trucks needed
Calculate average payload using utilisation function
Repeat until the most profitable solution found
transfer incremental costs & revenues to financial/economic analysis

Figure 3 Structure of shore-based analyses

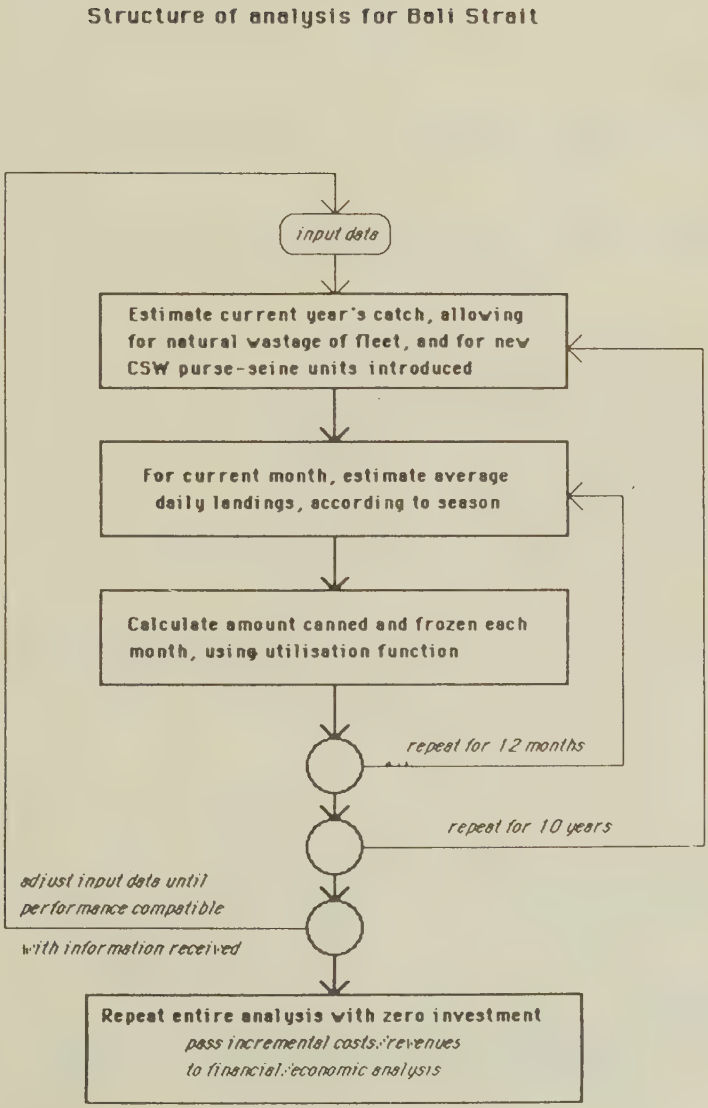
Structure of analysis for Bali Strait
input data
Estimate current year's catch, allowing for natural wastage of fleet, and for new CSW purse-seine units introduced
For current month, estimate average daily landings, according to season
Calculate amount canned and frozen each month, using utilisation function
repeat for 12 months
repeat for 10 years
adjust input data until performance compatible with information received
Repeat entire analysis with zero investment
pass incremental costs/revenues to financial/economic analysis

Figure 4 Structure of analysis for Bali Strait

APPENDIX 2

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